THE

# ELECTRICAL REVIEW.

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## ELECTRICAL REVIEW.

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THE

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## THE WIRELESS TELEGRAPHY BILL OF 1904.

THE memorandum of this Bill sets forth clearly enough the objects sought to be attained. The first paragraph virtually reaffirms the inalienable right of the Government to control the various established systems of wireless telegraphy in war time and national emergencies, a power which it has always held with regard to submarine telegraphy. This is so reasonable that it must naturally appeal to the common sense of all British subjects. But the Act goes far and away beyond this. It has three new and salient features of vital importance, in that it lays down—

1. That henceforth no wireless telegraph station can be established, and neither inland nor over-sea aerograms can be transmitted without a licence, under terms, from the Postmaster-General (subject to the approval of no fewer than three other Government Departments).

2. That the Government shall regulate the working of different stations; and

3. That the Government shall prescribe and enforce the conditions under which all stations may be worked, whether on land or on British ships. The Act, moreover, is so far-reaching that it covers all ships carrying the British flag throughout the high seas: it will thus be seen that whilst the Government acquires new powers with regard to inland telegraphy through the ether, the result as regards over-sea messages is to extend the monopoly which the Telegraph Act of 1869 conferred upon the Postmaster-General, from the present territorial limits around the coasts of Great Britain and Ireland to every part of the world. Notwithstanding the simple, and at first sight harmless, phraseology of the new enactment, these powers appear to be so wide and so indefinite as to inevitably lead to confusion and misunderstanding, besides seeming to place British shipping at certain disadvantages, which will be mentioned presently, as compared with foreign shipping.

The power now acquired by the Government to regulate the working of different stations for the purpose, as set forth, of securing the most efficient communication between all, apparently applies equally to peace time and to times when there is war or other national emergency in sight, and was possibly framed with the view of preventing interference, intentional or otherwise, by any one system with the working of any other system.

A careful perusal of the Bill suggests many interesting questions. Of these it will suffice to notice but a few. In the first place, is there any danger that the measure may serve to bring about that commercial monopoly in wireless telegraphy, which, presumably, it was introduced with the object, *inter alia*, of preventing? In granting a licence, is it not just possible that the authorities concerned may so interpret their powers as to be able to favour any one or more particular systems, or will all systems, *present and future*, be

placed on the same footing, provided only that they are inter-communicable at will, and that they can be worked independently over the same area?

The former contingency would mean the unfortunate extinction of certain now well established and efficient wireless telegraphic systems, and the cessation of all independent effort in this field, thus destroying at one blow that healthy competition upon which all evolution and improvement depends. Again, under the terms of its licence, will any one company be at liberty to refuse communications from any other compary or companies? Or, in other words, will it be permitted to arrogate to itself the exclusive right to produce ether vibrations, and thereby monopolise one of Nature's forces? For example, suppose a shore station be equipped with a certain system, "A." May the owners at their own pleasure, and for their own commercial advantage, legally refuse messages offered by duly licensed British stations or vessels fitted, say, with systems "B" or "C"?

This point assumes special importance in view of the refusal recently reported on the part of an American company to accept messages from an American war vessel, simply because she was not equipped with their own apparatus. Under the present Act, will any such proceedings be tolerated, or justly treated as a penal offence, or be dealt with in the summary manner recently adopted by the United States Government? On these and other important points, including the conditions attaching to the grant of licences and the amount of royalty which licensees or commercial users of wireless telegraphic equipments are to pay the Postmaster-General, this Act is silent, and its wide phraseology admits of various constructions, though its enormous powers are indisputable.

Referring to the disadvantages of the Act to British vessels as compared with foreign vessels, the measure can, of course, impose no conditions upon foreign ships, so that apparently, although unlicensed, they may nevertheless enjoy just the same privileges as duly licensed British ships. This places the unlicensed foreigner on equal terms with a British ship legally provided with a licence, while on the other hand the *unlicensed* Britisher, as compared with his foreign brother who requires no licence, is, in fact, nowhere! Again, will an unequipped British vessel on the high seas, which may find herself in distress, be infringing the Act by signalling with flags to some equipped foreign vessel, and transmitting through her a wireless message to a home port?

To epitomise the new enactment, it gives to the naval and military authorities in war time no powers which they did not previously possess, while in the case of commercial communication with other countries it would seem to be valueless, until some well-considered and definite international agreement shall have been arrived at with all countries using this new system of communication.

As no such international agreement or accord upon wireless telegraphy has as yet been arrived at, legislation in the matter might usefully have been postponed, until the entire subject had been discussed at the next quinquennial Telegraph Conference. So great and wide a subject as is opened out by this new field of experiment should have been left alone to be dealt with by such an eminently competent and authoritative body.

Such international agreement might usefully have been precedent to legislation, instead of following it. For the rest, the new measure is open to the construction that, although of only two years' duration, it may foreshadow and pave the way to a vast commercial monopoly which, by its far-reaching effects, may well inspire alarm in the minds of the public and of those who are concerned in this means of telegraphy.

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Standardisation of Electrical Apparatus.

THE interim report of the Standardisation Committee, which we published in our last issue, contains many interesting and important recommendations, which we trust may lead to marked reforms in the design and equipment of electrical installations. It is true that the work of the Sub-committee on Generators, Motors, and Transformers is as yet only commenced, and the greater portion awaits completion; but it is to be commended for its wisdom in giving us something to go on with in the meantime. Perhaps the most noteworthy pronouncement of the report is that which relates to the proper frequency to be adopted as a national standard. We are pleased to see that only one frequency is specified—namely, 50 cycles per second. It is possible without much difficulty to vary the pressure and current of electrical machinery over a wide range, by simply modifying the windings; but changes of frequency generally involve radical alterations in the design of castings and other standard parts, and by reducing the necessity of such modifications to a minimum, the problem of standardisation has been greatly simplified. As the ruling frequency in British A.C. supply undertakings is already 50 cycles, the adoption of any other standard would have been of no great benefit to manufacturers. The secondary standard frequency of 25 cycles per second is also in general use in connection with rotary converters, and as it is wholly unsuitable for general supply without conversion, it will in no way interfere with the primary standard. The successful results which have been obtained in running rotary converters on the higher frequency, both from the Isle of Thanet tramways power station, with reciprocating engines, and from Brimsdown, with steam turbines, indicate that even the 25-cycle standard is not indispensable; but practice changes slowly, and it is not likely that the lower frequency will be discarded for a long time, if at all.

Turning to the supply pressures standardised, it is noteworthy that amongst the "low pressures" are found 440 and 500 volts, both D.C. and A.C., whereas pressures above 250 volts A.C. are defined by the Board of Trade in their regulations as "high pressures"; again, the Board regards pressures above 3,000 volts as "extra high pressures," an expression which does not appear in the report under consideration. These differences are perhaps questions of nomenclature only, but nevertheless, they may lead to some confusion. Otherwise the pressures prescribed call for no special comment, as they are those most generally in vogue, and being subject to a permissible variation of 10 per cent. either way, they cover almost all the pressures declared by British undertakers.

Regarding the rating of generators and motors, matters of the very first importance, the report is incomplete, but satisfactory so far as it goes. Until the question of temperature limit is settled, it is impossible to form any opinion as to the effect of the specifications upon present practice, more especially as Colonel Crompton foreshadows values even more liberal than those laid down by the American and German Committees! We must confess that the odour of frying shellac, harmless though it may be, invariably arouses

our anxious suspicions and fills us with disquietude. We note, with some regret, that the B.H.P. rating of motors is perpetuated; doubtless the decision is well founded, but the use of two units of activity differing by a small and inconvenient fraction is obviously unfortunate, and only to be tolerated on account of the immense difficulty of abolishing the horse-power. The sub-committee has ingeniously striven to minimise the inconvenience by making the frame of a 10-B.H.P. motor identical with that of an 8-KW. generator, and so on throughout in the same ratio, up to 100 B.H.P., beyond which motors are not yet listed. The principal standard set up for alternators is the 6 per cent. pressure rise from full load to no-load, a rather curious regulation. The term "ventilated" for the third class of motors is likely to give rise to misconception, for it must be borne in mind that non-technical purchasers will frequently come in contact with the term, which really covers classes 1, 2 and 3. The definitions given for classes 2 and 3 savour of a distinction with very little difference—one is protected without interfering with the ventilation, whilst the other is ventilated without interfering with the protection. Why this laborious splitting of straws?

The standard specification for Tubular Tramway Poles, drawn up by the Sub-committee on Electric Tramways, of which Mr. A. P. Trotter is chairman, and issued in the form of an interim report by the Committee, is brief, but adequate. Three classes of steel poles are recognised, which may be either sectional or taper, 31 ft. long over all. The usual tests are prescribed, and in fact there appears to be no variation from what has already, by common consent, become standard practice.

The Standard Tables of Copper Conductors, and Thicknesses of Dielectric, evolved by Mr. R. Kaye Gray's Sub-committee on Cables, are the fruit of arduous labours, in which Mr. John Gavey, C.B., and the Sub-committee on Telegraphs and Telephones have shared. The standards of the Cable Makers' Association have been adopted almost unchanged, the alterations consisting mainly of the elision of superfluous decimals, and an increase in the lay adopted in calculating the tables. The latter are given in detail on a rational basis, four significant figures only being given, as in the resolutions; they include standard radial thicknesses for jute, paper, rubber and lead, together with the tests which cables of various descriptions must pass. Standards for armouring, with steel wire and tape, are also given, the lists being very comprehensive.

There remains to be noticed the volume dealing with the "Properties of British Standard Sections," a work of the utmost importance to mechanical engineers, and produced jointly by the Committees on Shipbuilding, Bridges and General Building Construction, and Railway Rolling Stock Underframes. In the first part of this volume the theory and calculations employed are ably expounded by Mr. Max am Ende; in the second part are given nine lists, showing the dimensions, weights, moments of inertia and resistance, and radii of gyration of all the sections standardised, with a reference number and code word for each. No engineer who is called upon in the future to design steel structural framework of any magnitude can afford to be without this invaluable reference book.

In conclusion, we may note that while the reports of the Engineering Standards Committee are called Interim Reports, their terms are definitely adopted. They are only "interim" pending the issue of the final and all-embracing Report of the Committee.

**Imports of Foreign Electrical Machinery.** — The imports of foreign electrical machinery into this country during July amounted to only £46,732, bringing up the total for the first seven months of the year to £316,176, as contrasted with £357,746 in the corresponding seven months of 1903.

## ELECTRICITY IN THE HOSIERY MANUFACTURING TRADE.

By E. J. WILLIAMS.

During the last 10 years the old hand frame for hosiery manufacture has been gradually superseded by the power frame. There are various types of these; circular knitters, and straight rotary frames making from four to 12 garments at once.

When the power frame was introduced the only available power was steam, and the manufacturer usually started in a small way, putting in two or three frames, a small milling plant for washing the goods, and a small engine and boiler, the latter for supplying steam for heating the factory, boiling the water for the milling, and drying the goods, as well as for running the engine. As the trade grew, more frames were put in, and extensions made to everything but the power plant, and the result in many cases to-day is that the boilers and engines are sadly overloaded, and the driving is anything but satisfactory.

But at the same time these manufacturers are slow to change the old order of things, one objection being that they must retain the boiler, and allocate a portion of a man's time to it, even if they adopt electrical driving.

In the hosiery centre in which the writer is located, the factories are very similar; the machinery is the straight rotary frame, and the driving plant consists of a cylindrical boiler about 14 ft. × 5 ft., working pressure 35 to 45 lbs., feed-water heater, and a horizontal engine of about 10 H.P. with boiler feed pump attached to eccentric. The driving plant is run by an "engineman," who, in some cases, does odd jobs as well. His wage is usually from 19s. to 25s. per week.

The manufacturing plant proper is a fairly steady drive, but the milling plant is very intermittent, and as it takes about 5 H.P. at starting up, and as this often happens when the "engineman" is away on one of his odd jobs, or when he has all he can do to keep his steam, the result is that the steam pressure falls, and the whole factory is running slow until the milling plant is shut down, or the steam pressure has recovered.

Many of those engaged in the hosiery manufacturing trade have yet to learn how much they are losing by this continual and often unsuspected running slow. It is only recently that the writer himself appreciated what the loss in this trade really means. He had often discussed the advantages of a steady drive like electricity with the manufacturers, and with the workers themselves, but he did not at that time realise its full value, and what it means in relation to the output.

In these steam-driven factories with the constantly varying speed, it is difficult to get good regular work off the machines. For instance, when the speed is high, the yarn is drawn tighter and the garment is knitted closer. When the speed is low the reverse obtains, and it is often the case that a garment will come off the machine with one leg shorter or longer than its fellow, sometimes to the extent of $\frac{3}{4}$ in., and this, of course, means waste of material, and time and money in "finishing" the garment. Considerable time is lost, too, if the machine is run above its rated speed, by the "casting off" of the yarn, which entails a stoppage to rectify it. Another fault that is accentuated by over-running, is the breaking of "sinkers," small steel plates which make the loop, and as these cost from 16s. to 21s. per hundred, and an over-run frame will break as many as six or eight in a day, this item is a pretty serious one.

To bring home to the manufacturer the superiority of the electrical drive over steam or gas, the writer improvised a simple apparatus for taking and recording the variations in the speed of the shafting in the factory. These records, taken as they were under actual working conditions, are very interesting, and very valuable when trying to do business with men in a similar, or any, manufacturing trade.

Chart No. 1 was taken off the line shafting in a factory employing about a hundred hands. It will be noticed that during the $2\frac{1}{2}$ hours under observation 500 revolutions were lost, in this instance representing a loss in output of 510 in. of cloth, and that, too, assuming that a quarter of the

machines were "making ready" during the time the revolutions were lost.

This 510 in. of cloth would make, say, 10 garments. Assume that this chart would hold good once a day for 300 working days per year, the loss works out at 3,000 garments per annum. That the reader may better realise what this means, it may be said that an average year's output of an eight division, 24-gauge, rotary-frame, is about

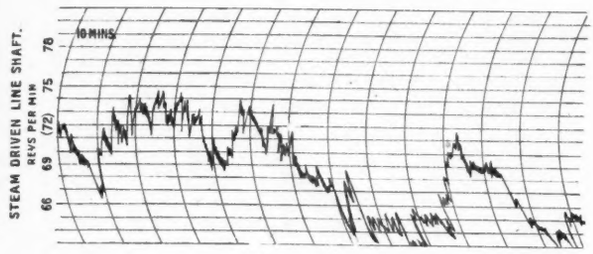


Chart No. 1.

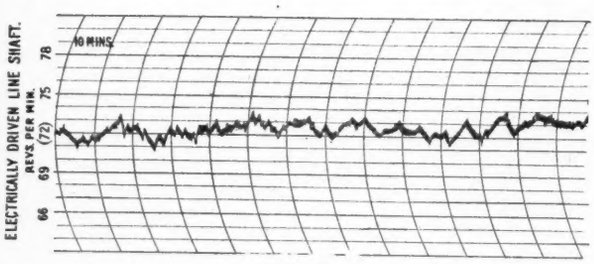


Chart No. 2.

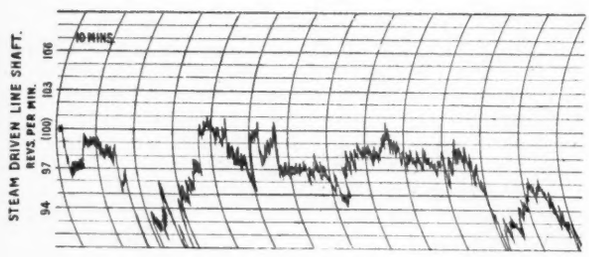


Chart No. 3.

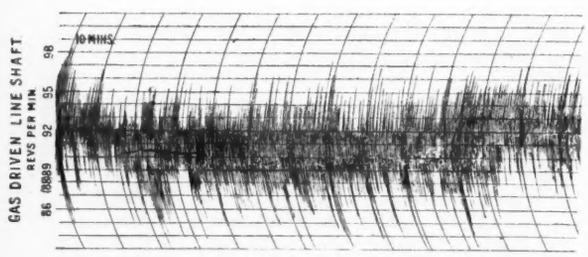


Chart No. 4.

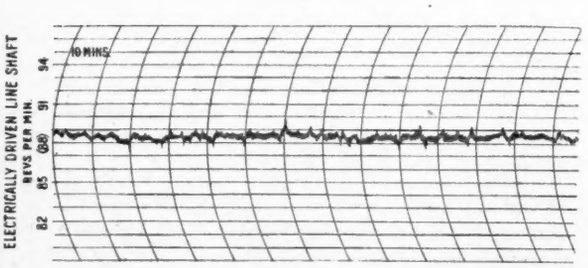


Chart No. 5.

750 dozen, and that the frame costs about £450. Hence the annual loss would be the output of four frames costing together £1,350.

This tremendous loss is so unsuspected until a record similar to this chart is taken, that it at first sight seems impossible. Nevertheless it is a fact which is becoming self-evident, and the writer's experience, spread over the last two years amongst this class of work, has borne out the above figures.

Chart No. 2 shows a very marked difference. It was taken off the same shaft as Chart No. 1, and under the same conditions of load, but the source of power was electricity. It would have been better but for the reason that the motor leads were taken off at the same point on a small main, as the leads for a motor driving the milling plant, which it will be remembered, runs very intermittently, and when switched on dropped the pressure at that point. The motor was provided with a field regulator, but this was not touched during the time the chart was taken; the slight rise in speed towards the end of the run was due to the temperature rise of the motor.

Chart No. 3 was taken from another factory, and although smaller than the first, still the loss was very considerable—627 revolutions, representing 360 in. of cloth.

Chart No. 4 was taken from a factory driven by a new gas engine. The shaft speed should have been 88, but, as will be seen, was considerably higher. The startlingly unsteady drive is very bad for such delicate and costly machinery as that used in hosiery manufacture; the breakage of "sinkers" is alarming, and the time lost through the "casting off" of the yarn is considerable. There is a marked loss in output, though this cannot be altogether demonstrated from the chart, and is a matter that only carefully watched experiments will show.

Chart No. 5 was taken off the same line shaft as No. 4, when it was driven by a motor, and under the same conditions. It is better than No. 2 motor chart, as there were no disturbing conditions, and for the reason that it was taken off a third line shaft, as was the gas chart, whereas No. 2 was taken off a first shaft.

So infinitely superior a drive is electricity here shown to be, that the question of price should be of secondary consideration with the hosiery trade. But, on the contrary, it is the cost first, last, and nearly always; and if you are a supply company's engineer, and know the value of what you are selling, it will nearly break your heart to find that, unless the price alone will bear comparison with the price of gas or steam, you can do very little business.

In conclusion, it may be mentioned that with electricity at 1½d. per B.T.U. the cost of electrical driving at the factory where Nos. 1 and 2 charts were taken was found to be less than the steam costs to the extent of 9s. 6d. per week, which, in this instance, meant a saving of 17 per cent.; and it must be remembered that the output has increased considerably, that the breakages of "sinkers" and parts have been reduced to a minimum, that the cloth is better, and that there is no waste of time and material in finishing off garments having odd measurements caused through the varying speed.

The hosiery trade is beginning to appreciate the manifold advantages of the electrical drive; old factories, now steam and gas, are changing over to electricity, and new factories will consider no other power if electrical energy is available.

## TECHNICAL EDUCATION: THE STRENUOUS LIFE.

By A UNIVERSITY LECTURER.

Last year I was very much grieved when one of my students announced his intention to leave an English University in order to finish his engineering education in the States. Last week he wrote me a long account of his doings out there, and now I am glad that he had sufficient energy and enterprise to go. He has sent me, among other newspapers and periodicals, some journals published by the engineering departments of these American Universities, notably those from Harvard, Cornell, and Iowa. These, and the impressions made upon my past student's receptive mind, have given me much food for reflection, and provided many thoughts upon which to ponder. And as I looked through these American University calendars and periodicals, there came to my mind the words of

a well-known man of science, that in the United States there are almost as many professors, lecturers, and instructors in the universities and colleges, as there are day students in the universities and colleges of Great Britain. Perhaps this is because during the last few years such colleges in the States received more than forty millions sterling in the shape of gifts (in three years, 1898—1900, private effort supplied nearly seven million pounds), while we in England have received, during the past 60 years, less than four million pounds. But one other thing was evident, namely, that the average American student in engineering believes in the strenuous life; the English undergraduate does not take his work so seriously, nor with such intense earnestness.

My student-friend was, in his way, a great athlete when on this side. At Cornell he takes just the amount of exercise which he finds necessary to keep him in good health. He tells me that a few of his fellow-students become famous in athletic contests; but they are exceptional men whom Nature has endowed with active brains and sound bodies far beyond the average. There is but little time for social pleasures, for the ordinary man who wishes to graduate must work from 9 to 10 hours a day in the study, shops, drawing rooms, or laboratories of the college. Yet my friend has been surprised to find that the average American student, although, perhaps, quicker at seeing things than the Englishman, does not retain his knowledge so easily. He also tells me that out in the States they have a Society for the Promotion of Engineering Education, and that this society emphasises the fact that the great need of the profession is men with technical knowledge and proficiency resting upon a broad basis of general culture, so that there might be opened up to them the wider worlds of learning such as enable them to obtain a largeness of view, judgement, and an easy knowledge of men. It was the president of the Princetown University who said that "the college should seek to make the men whom it receives, something more than excellent servants of a trade or skilled practitioners of a profession."

There is one thing which the American lecturer always impresses upon his students—that it is not only in university and technical colleges that the leaders of thought and captains of industry are trained. There is the larger school, the school of the world. But the President of the Princetown University tells us that the colleges bring to the consciousness of young men, by shorter and less dangerous processes, the various schools of experience which make raw lads become men of the world at the end of a four years' course.

At the Syracuse University, the Dean of the Smith College of Applied Science firmly believes in the strenuous training for the engineering student. He believes in the graduate completing his four years' course at the age of 23, and he pleads, as I think most of us who have to do with engineering students plead, that the training in the preparatory school should be as broad as possible. The reasoning power is developed by continued exercise and occasional intense and concentrated application. The student develops his brain by the aid of such studies as language, mathematics, and sciences, and the sooner that he commences this development (in a sane fashion, for no one wants the infant prodigy) the better for his college course. It is really astonishing how woefully ignorant of their mother tongue some technically accomplished engineering students are. Not long ago I looked through some of the papers written by candidates for the Science and Arts Examinations, and in many cases the spelling was almost unbelievable. One instance is "gas-*meater*." That was the rendering of more than one candidate! Therefore, we can all heartily endorse the American Dean's plea for a liberal elementary education. Then, bluntly, he says that all would-be engineers should have a year of 10 hours a day in a large works in order that he may "find himself," as Kipling says; or discover whether he has found for himself the right profession. Experience in England at Universities teaches us that a large number of the undergraduates who are naturally "smart" enough to obtain degrees, are not engineers, and never will become engineers. These are the class of men who would be "smart" enough to get through any examinations, and about the best thing that they can do is to compete for some of the posts under Government, where, once they have entered the portals of officialdom, there is no competition. In the strenuous streams of life their veneer gets washed off. They do not love their work; they would have made, perhaps, excellent doctors, lawyers, or even ministers, but they do not possess engineering instincts.

Then the American Dean wants the engineering student to have a year's training at a College of Liberal Arts, so that he may correct the defects in his training in English in the preparatory school, and learn how to write English composition without glaring errors in spelling and rhetoric. Here he is also to study physics, chemistry, mathematics, and German, still for 10 hours a day.

Then he is to do a four years' course at Cornell or elsewhere, and at the age of, say, 24, after a six years' training of 10 hours a day, he should be able to start off earning, at the start, 50 dollars a month.

One curious thing upon which my past student—I might almost say my present teacher, for he has indeed taught me many things—comments strongly. That is the fact that the American firms seem to give a preference to Englishmen. He says that English engineers do uncommonly well in the country beyond the Atlantic. The employers say that your man from England has more perseverance than the American. The most gratifying thing that I can find in my friend's correspondence, is that the new surroundings and people have changed his own ideals. In this country *his* perseverance carried him into the cricket and football teams of his college, and made him "cut" lectures and laboratory; out there he has shown the American undergraduates that the Englishmen only needs competition to stimulate him to perform great things. For my genial, but, in England, almost hopeless, engineering student has felt the good effects of the strenuous life, and we shall hear more of him in a field more useful to his fellows, than that where he used to win triumphs and shouts of praise by knocking a solid ball about all through the summer, and kicking a hollow one about during most of the winter. The strenuous life has taught him many things. In his next letter, I shall almost expect him to paraphrase some famous words, and write me as follows:—

> I played and thought life was for pleasure,
> I worked and found life's greatest treasure.

It is a pity that Mr. Cecil Rhodes did not include other universities besides Oxford in his scholarship scheme. For myself, I would be glad if America would "dump" about 20 engineering students into certain college laboratories, in order that they would set an example to our own undergraduates.

## PRIVATE BILL LEGISLATION OF THE PAST SESSION.

(By Our Parliamentary Representative.)

Compared with previous years, the session just closed has been one in which the schemes of an electrical nature have been in the main of minor importance. In fact, this remark applies generally to the Bills promoted, both by private speculators and municipal bodies, and also by the great railway and other companies. The slack state of the money market has undoubtedly affected the operations of speculators and companies, while the agitation against municipal trading has had a sobering effect upon those responsible for the initiation of schemes for trading with ratepayers' money. While, however, Parliamentary lawyers have had little reason to congratulate themselves, a considerable amount of useful private legislation has been enacted, which will enable those already possessing powers to develop them to better advantage. This has been especially noticeable in the case of electric power companies who obtained their Acts some years ago, and who now are beginning to get to work, and are finding out their weak points, and are strengthening them. Tramway operators, and especially those responsible for big schemes, are also finding out the value of connections here and there, and in a good many cases their Bills, although when glanced at appear to be by no means of a heroic nature, are yet of far greater importance than at first sight appears. Altogether 199 private Bills have been before various committees, and of these 71 were either wholly electrical or contained some electrical clause.

Owing to the continued sittings of the Royal Commission on London Locomotion, the many tube railway schemes for London, suspended two years ago, were again hung up, but the Baker Street and Waterloo Railway and the Charing Cross, Euston, and Hamp-

stead Railway Cos. each carried through Bills allowing them to make deviations from the authorised schemes and to raise further capital of, in the first case, £330,000, and in the second case, £300,000. The Great Northern and City Railway obtained an extension of time for the completion of their railway. The only new tube scheme brought forward was for the construction of a new railway under the Thames to join up North and South Woolwich. In this case the London County Council as usual intervened and got the Committee to insert a clause to the effect that should the County Council itself construct a tunnel in the same district, the railway company should be debarred from seeking compensation. Seeing that the capital of the company would have been £200,000, and that investors look for dividends and do not as a rule pose as philanthropists, it was hardly to be surprised that the promoters withdrew the Bill. The Bridges Committee of the County Council would, however, in this matter seem to have been hoist with their own petard, for immediately they had put a spoke in the wheel of the private company they rushed a scheme before the Council to go to Parliament for powers to construct a tunnel themselves and, having been once defeated, they will now ask Parliament to give them the powers on condition that they are not used for a certain number of years. Thus the thousands of working people in this locality have been prevented from having a much needed means of communication by the action of their representatives. Both the Metropolitan District Railway and the Metropolitan Railway have obtained further powers during the session. In the case of the District the very important scheme for zone fares went through, while the Metropolitan will be able to carry out a share conversion scheme affecting £7,675,924 of stock at par value, and are empowered to raise £750,000 additional capital.

Tramway schemes have occupied a considerable amount of the time of the Committees, but few of them are of great importance. A point of considerable importance was raised on standing orders in connection with a Bill of the London United Tramways Company. Under the title of "The London United Tramways (Railways) Bill" the company sought to obtain powers to construct a tunnel under the Thames at Hammersmith, which would enable them to join up their system north and south. The tunnel was in the area of the London County Council, and obviously the idea of promoting the scheme as a railway was to prevent the Council becoming the purchaser under the Tramways Act. The County Council successfully upheld their contention before the examiner that it was a tramway scheme and not a railway scheme, and consequently as the necessary notices for a tramway to comply with standing orders had not been given the Bill was struck out. The company, in another Bill, obtained powers to construct further tramways in Middlesex, which will still further add to the attractions of their already fine service. Perhaps the most important Bill of the Session with regard to tramways was that of the Tyneside Tramways and Tramroads Co., the final settlement of which was delayed right to the end of the Session, and the facts of which are doubtless fresh in the minds of the readers of the Electrical Review. A House of Commons Committee, under the chairmanship of Sir E. Strachey, allowed a clause in the company's Bill, giving mutual running powers over the lines of the company and those of the Newcastle-on-Tyne Corporation, and this at once aroused the ire of the Municipal Corporations' Association, who, by the aid of active lobbying, were able to get the House of Commons to send the Bill back to the Committee for reconsideration. The Committee stuck to their guns and the result was an agreement between the parties Each will have running powers over certain tramways, several of which are situated in the areas of local authorities outside Newcastle, and are not thus purchaseable by the Corporation. If, however, these lin s are purchased by the local authorities, the company will receive no enhanced value from the fact that there are running powers over the tramways of the Newcastle Corporation. Some interest attached to the Torquay Tramways Bill, inasmuch as the Dolter Electric Traction Co. are constructing their system here for the first time. The Wakefield and District Light Railway Co. obtained power to lay down a considerable number of tramways which it is intended to join up with other authorised and constructed schemes, the whole making a very big enterprise. The Harrow Road and Paddington Tramways Co. were allowed to transfer their undertaking to the Metropolitan Electric Tramways Co., but the Bill to electrify the London, Camberwell, and Dulwich Tramways was thrown out. The various schemes for tramway extension around Preston were not very successful, for the Preston and Blackburn Bill was thrown out, and the Preston and Lytham Bill withdrawn. The Preston, Chorley, and Horwich Bill, which enables fresh capital of £100,000 to be raised, went through, as did the Southport and Lytham Bill, which contains a clause enabling the Corporations of Blackpool and Southport to subscribe the capital. The Middlesbrough, Stockton-on-Tees, and Thornaby Tramways got a Bill through allowing them to construct additional works, as did the Bristol Wagon and Carriage Co. A new company was authorised to construct tramways at Holywood with a capital of £54,000. A number of corporations and local authorities came forward with Bills, by far the most important being that of the Belfast Corporation, which will enable the tramways in that City to be electrified. The Newcastle-on-Tyne Corporation are authorised to construct an additional nine miles of tramway, and the local authorities of Leyton, Rotherham, Great Yarmouth, Bournemouth, Wallasey, Wolverhampton, Chesterfield, Stretford, Swindon, Ilford, Radcliffe, Manchester, and Barrow, are all authorised to add to their existing systems. Of the many proposals brought forward by the London County Council, only a few were allowed, while a big scheme for the construction of a system in Mid-Cheshire was withdrawn.

Twelve Bills relating to electric power companies were before the House, of which the following were new:—

| Company. | Proposed capital. |
|---|---|
| East London and Lower Thames ... ... | £2,000,000 |
| Belfast and North-East Ireland Electric and Power Gas ... ... ... ... ... | 1,500,000 |
| Cheshire Electricity and Power Gas ... | 1,000,000 |
| North Wales Electric Power ... ... | 1,000 000 |
| Lincolnshire and Yorkshire Electric Power | 996,000 |
| Ulster Electric Power ... ... ... | 900,000 |
| Lothians Electric Power ... ... ... | 600,000 |

Of these a committee of the House threw out the East London and the Cheshire schemes, while the Lincolnshire and Yorkshire and the Ulster Electric Power Bills were withdrawn. Other power companies coming for additional powers were the Lancashire, the Leicestershire and Warwickshire, the Derbyshire and Nottinghamshire, the Clyde Valley, and the North-Western Electricity and Power Gas. The two chief things asked for in these Bills were powers to erect generating stations on lands other than those scheduled in the Companies' Acts, and powers to take over the electric lighting orders granted to local authorities. Some discussion took place before the Chairman of Ways and Means as to the form of the clause to be inserted to carry out the latter object, but so far the Board of Trade appears to have laid down no form. A precedent was made in the case of the North Wales Bill which may be useful in the future, inasmuch as the consent of an urban district authority was dispensed with with regard to the erection of overhead wires. Previously the dispensation applied only to rural authorities.

Most of the electric lighting schemes came before the House by way of Electric Lighting Provisional Order Confirmation Bills, and a keen fight took place as to the insertion of the Bermondsey clause. In a fair number of cases a kind of modified Bermondsey clause was inserted, but the Committee only inserted it where it was asked for. The Marylebone Borough Council got through its Bill to enable it to get out of a muddle of its own making with the Metropolitan Electric Supply Corporation.

Few of what may be called miscellaneous Bills were of interest electrically, but the Portmadoc Beddgelert and South Snowdon Railway have obtained powers to construct an electric railway at Snowdon, and the North Staffordshire Railway Co. has authority to work its railways and canals by electrical power.

## THE ELECTRIC RAILWAY FATALITIES.

### The Board of Trade Reports.

The following are copies of the complete reports by the Board of Trade inspectors respecting three of the recent third-rail fatalities:—

#### Lancashire and Yorkshire Railway.

Railway Department (Board of Trade),
8, Richmond Terrace, Whitehall, London, S.W.,
*July 12th*, 1904.

Sir,—I have the honour to report for the information of the Board of Trade, in compliance with the order of June 16th, the result of the inquiry held by me, in conjunction with Mr. Trotter, into the causes of the fatal accident which occurred on June 9th to Patrick Flood at Formby, on the Lancashire and Yorkshire Railway.

In this case, Patrick Flood, while trespassing on the railway, came in contact with the "live" rail (the section of the line at this place being fitted for electric traction), and was killed by the shock. A man named Mathews, who was with the deceased, also received a bad shock and burns, but recovered. The evidence available is simple, and is to the effect that the fireman of a shunting engine, by name J. Rigby, employed in the sidings of the power station at Formby, about ½ mile south of Formby station, heard a shout at about 3.20 p.m. on the day in question, and, looking towards the line, saw two men lying across the "live" rail about 40 to 50 yards away from him. He told his driver, F. Evans, who was alongside the engine, who at once ran across to the power station 40 yards or so away to tell the attendants. Rigby at once ran to the men but did not touch them. He describes the position of each of them on the railway in his evidence.

F. Evans, on reaching the power station, at once told the switchboard attendant that some men were on the "live" rail, and Mr. O'Brien, the resident electrical engineer at the station, who was in the engine room, on hearing the report at once had the current cut off and ran out to where the men were lying. He immediately lifted both clear of the line, and with his assistants tried to restore them by means of artificial respiration, with the result that one man, Mathews, came round, but Flood was dead. Evans, the driver of the engine, states that it was two minutes at the outside from the time Rigby told him of the men being on the rail to the time the current was cut off, so this was done and the men were removed from contact with the "live" rail with as little delay as possible after the occurrence.

Flood appears to have received a more severe shock than Mathews, owing to his boots being so worn out, that if he stepped on to the "live" rail, as he probably did, he would be practically bare-footed, and as it had been raining heavily just previously, all the conditions were favourable for a very bad shock, and it is very probable that he was killed instantaneously on stepping on to the "live" rail.

The men had not been noticed previously to their being seen on the rails, but it is supposed that they got over the fence just opposite the power station, and were crossing the line to go to it.

It will be seen that this occurrence was entirely due to the men being trespassers on the railway. The nearest public level crossings for foot-passengers are 245 yards north of the point where the men were found, and 452 yards south of that point respectively. There is also a private footpath for the River Alt Commissioners 105 yards south of this point. There are notice boards at all level crossings pointing out the danger to trespassers from the electrification of the line in addition to "Beware of train" notices. The new electrification notices have also been put up on the side of the line at places where people might be liable to trespass, such as alongside golf courses.

The line is well fenced; the fencing near Formby power station consists of posts and five rails, the top rail being 4 ft. 3 in. to 5 ft. above ground level.

Speaking generally, the company have protected the power rail wherever the public or company's servants (other than platelayers) have any occasion to be on business or duty along the whole of the line worked electrically. At the sides of bridge girders, in stations and alongside sidings, signal boxes, &c., protection has been given by either single or double boarding, the total length provided being 10 miles of double boarding and 6¼ miles of single boarding out of a total length of single line of 47 miles. At level crossings the power rail ends 6 ft. away on either side, and the current is carried under the wood decking by cables, and the ends of the power rails are protected by double boarding for a length of about 10 ft. With regard to the protection of platelayers engaged, the gang I saw at work at Formby had the lower part of their shovel handles (*i.e.*, where the iron straps of the shovel are fastened to the handle) protected by insulating material, and I was told by the men that this protected them from shock if they accidentally touched the power rail with their shovels when packing the sleepers. The beaters have no metal work likely to come in contact with a man's hands when using them.

Special precautions are, of course, taken for the protection of the men employed on the upkeep of the power rail, &c.

The provision of the protecting boards, especially the inside one between the power and running rails, makes the work of packing the sleepers more difficult, as it is just under the running rail that packing is most required, and anything making that difficult is undesirable from a platelayer's point of view. The upkeep of the protective boarding will also require much attention, as the clearance between the shoe and the boarding must necessarily be small, and the latter will be liable to get out of place from the action of rain and sun; any contact between the two might easily result in a serious derailment. As far as experience goes at present, it does not appear necessary to provide boarding for the "live" rail for the whole length of the line in order to protect the men employed in working the traffic, repairing the line, &c., or the passengers.—I have, &c.,

E. Druitt, *Major*, *R.E.*

I concur with the foregoing report.

A. P. Trotter, *Electrical Adviser to the Board of Trade.*

The Assistant Secretary,
Railway Department, Board of Trade.

*Evidence.*

John Rigby, acting fireman, states:—I have been about 18 months in the company's service. On June 9th, about 3.20 p.m., I was on a shunting engine in the yard at Formby power station, and suddenly heard a shout and saw two men on the "live" rail. They were about 35 yards away from me. I had not seen them previously. I jumped off the engine and went to the men. One was lying with his chest on the power rail of the up line and the rest of his body in the six-foot, but not touching a running rail. The other had his legs across the power rail of the slow line to Southport, and the rest of his body in the six-foot; his face was also just touching the up power rail. This was the man who was killed. I did not touch the bodies. Mr. O'Brien came up first. The two men were about a yard apart. It had just finished raining, sufficient to wet a man's clothes.

Mr. O'Brien, resident electrical engineer at Formby, states:—On June 9th, about 3.20 p.m., I was in the engine room when I was told a man was on the third rail, so I told the switchboard attendant to take his circuit breakers out and to tell Seaforth substation to do the same, which would have the effect of cutting off the power for the section Formby-Seaforth. I then ran and took off my coat and lifted the men into the six-foot. Their position was practically as described by Rigby. We then lifted the bodies clear of the line and started artificial respiration. One came round but the other did not. The man who was killed had worn-out boots and was practically in stockings. There have been a considerable number of accidental shocks—(1) people accidentally touching rails in course of their work, and (2) platelayers accidentally touching the power rail when stepping over the rails, but I have not heard that this tended to knock a person down. In dry weather and with good boots nothing results. The power current is of 600 volts, which is practically the same as 500 volts as far as the effect of the shock is concerned.

F. Evans, acting engine driver, states: I have been 17 years in the company's service, and on June 9th, about 3.20 p.m., my mate shouted to me that some men were on the "live" rail. I ran to the power house to fetch some gloves, and signalled to the switchboard attendant Slattery that I wanted some gloves. He came down off the switchboard and I told him there were two men on the "live" rail. He told Mr. O'Brien, who was close by, who ordered the current to be cut off. It was two minutes at the outside from when my mate told me to when the current was cut off.

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North-Eastern Railway.

Board of Trade (Railway Department),
8, Richmond Terrace, Whitehall, London, S.W.,
*July 12th*, 1904.

Sir,—I have the honour to report, for the information of the Board of Trade, in compliance with the order of June 21st, the result of my inquiry into the circumstances under which a fatal accident occurred to porter Joseph Innes at Manors Station, on the North-Eastern Railway, on June 13th.

On the above-mentioned day, about 12.45 p.m., porter Innes was found lying dead on the line close to the down end of Manors Railway Station. He was found in the 6-foot way between the up and down Tynemouth lines, and he was lying on his face parallel to these lines. The back of his head was in contact with the live rail of the up Tynemouth line and his face was touching the point rods which pass under the lines at this spot. Life was quite extinct at the time he was found.

*Description.*

Manors Station, where this accident occurred, is the first station on the down side of Newcastle Central Station on the main line of the North-Eastern Railway from Newcastle to Berwick.

There are four passenger lines running through the station in directions which are approximately east and west; these lines consist of the up and down main lines, which are on the north side of the station, and the up and down Tynemouth lines, which are on the south side of it. All four of these lines have quite recently been fitted for electric traction, and alongside each of them is a live rail carrying a current of 550 volts, contact with which is made by a shoe attached to the car. A man crossing the line at this point would, therefore, have to cross four of these live rails.

These live rails are fixed in the six-foot ways between the respective up and down lines. In each case the live rail is 19½ in. distant from the nearer rail of the line which it serves, and 3¾ in. higher than it.

On both the north and south sides of the passenger lines are sidings, which are not, however, fitted for electric traction.

On the north side of the lines at the down end of Manors Station, there is a goods station, known as the Trafalgar goods station, and on the south side of the lines opposite to it there is a granary belonging to the company.

The two live rails alongside the up and down main lines at the down end of the station are protected in the following way:—On each side of these rails is fixed a wood guard about 3 in. distant from the rail, and extending to a height of 2 in. above the upper surface of it. This guarding will to a great extent prevent the possibility of a person coming into contact with the live rail, whilst it does not interfere with the action of the shoe.

The live rails alongside the up and down Tynemouth lines are similarly protected, but only to a very small extent, and at the point where Innes's body was found there was no guarding at all.

The company's explanation of this difference is that there is a much larger necessary traffic of company's employés between the passenger station and the goods station across the main lines than there is between the passenger station and the granary across the Tynemouth lines.

Porter Innes, to whom this accident occurred, was employed working a capstan at the granary.

The main entrance to the granary is, it may be mentioned, from the road on the south side of it, quite clear from the lines.

*Evidence.*

Dr. Frederick Page states: I am surgeon for the Northern Division of the North-Eastern Railway. When I first saw the deceased, he had been removed to a shed, and he was then dead. I have no doubt that the deceased died from the action of the electric current on the *medulla oblongata*, which is the most vital point of the nervous system. The neckerchief round his neck was burnt through, and there was a hole burnt in the soft part of the neck about half the size of one's fist. There was nothing to indicate that the man had been knocked down by a blow. The only sign of injury which I could detect was that caused by the electric current. It had, I think, been a showery day, and the man's clothes were dry. There was no discolouration at the time I made my examination.

Peter Robertson, assistant foreman, states: I am employed as assistant foreman at the granary, and have been employed there 29 years. The deceased had been employed under me 19 years. I last saw him at 12.20 p.m. on the date the accident occurred. He was then inside the office inside the granary. He had come into the office to take away the can containing his food, and he went outside the office with the can. He did not mention what he was going to do. I thought, however, that he was going away for his dinner. His regular dinner interval was from 12 to 1, but on this day he had remained on at work till 12.15, so he was quite justified in then going away for his dinner. I did not see him again until after his death. About 12.45 p.m. a man shouted to me that Innes had been caught by the live rail, and I went out at once to see what had happened. I found the body lying face downwards between the up and down Tynemouth lines. The front of his face was lying on the point rods, and the back of his head was a short distance from the end of the live rail when I saw him. There were already some men with him when I got to him. I have often seen the deceased eating his dinner in the granary, so at all events he did not always cross the line to take his dinner. He was, however, in the habit of crossing the line to get to the w.c. There is a w.c. in

the granary, so it was not necessary for the deceased at any time to cross the line to get to the w.c. on the other side, but as he was working on top he probably thought it a more convenient thing to do. I have known cases in which the deceased has had to cross the line on duty. In fact, a certain number of the men have now and again to do so. Some of our men have occasionally to discharge wagons in the warehouse of the goods station, and for that purpose they have to cross the line. On June 11th notice was given to the men that the electrification of the line would take place from the following day up to the next Friday, and written notice was posted in a conspicuous part of the inside of the granary, and was also given to the men in pamphlet form to the same effect, and about 9.30 a.m. on June 13th I reminded deceased verbally to take care of himself, as now the rails were charged with electricity, and he replied, "All right." The deceased had commenced duty at 7 a.m. on the morning of June 13th. He had been employed for 19 years under me, and I can give him a very good character.

John Craggs, driver, states: I have been 15 years in the service of the company, during 5½ of which I have been a driver. I was working the Bank Top pilot engine which works the wagons to and from the granary. At the time I first saw the deceased I had about seven wagons on my engine. I was running under Argyle Street bridge, just on the east side of Manors Station, when I saw flame and smoke on the line in front of me. I looked carefully, and saw a man lying on the line, and I at once said to shunter Kirton, who was riding on the footstep of the engine, "There is a man on the line; run and pull him off at once." I at once got off my engine, and followed Kirton up. I found the deceased lying with his face on the point rods, and the back of his head under the end of the live rail. He was lying in the 6-foot way parallel to the rails, with his feet in the direction of the Argyle Street bridge. He was dead when I got there. There was a mark on the side of his face as if he had touched the live rail with it. The back of his head appeared charred. I did not see any signs of blood, nor did I notice any hole in his head. His face and hands had a bluish tinge. The shunter removed him out of contact with the live rail, and we at once turned him over and found that he was dead.

George Kirton, shunter, states: I have been 10 years in the service of the company, during about seven of which I have been a shunter. I remember seeing the deceased shortly after the accident occurred. When I first saw him I was riding on the step of driver Cragg's engine, and at the time we were on the granary siding under the Argyle Street bridge. Driver Craggs shouted to me that he saw a man lying on the rails, and he told me to go and pull him off. I at once ran up and I saw deceased lying on his face. He was lying in the 6-foot parallel to the rails, his feet being towards the Argyle Street bridge. The deceased's face was touching the point and signal rods, and the back of his head was touching the live rail. I at once got hold of him by his trouser and pull him clear of the rail. I at once felt sure that he was dead, and I called to another shunter to bring a stretcher. I saw a big mark on the back of the deceased's neck. It was black and blue and looked like a burn. I saw no other marks on him except on the back of his head. His face and hands had a bluish tinge. We subsequently found that he was undoubtedly dead. I am employed permanently as a shunter at Manors. I have myself seen men crossing between the granary and the goods station at the particular point at which the deceased was found, and I myself have often to do so. I myself have never received any shock from the live rail. At the time I found the deceased it was raining slightly, and it had been raining heavily previously.

Thomas James Sharp, permanent way inspector, states:—I am permanent way inspector of the section of the North-Eastern Railway which includes the point where this accident occurred. At 12.20 p.m. on June 13th, I saw the deceased. I met him midway between the granary and the street entrance. He said to me "If I get killed in passing over the line, Mr. Sharp, I will lay the blame on you." The deceased at that time was going towards the granary. He had not his dinner in his hand. I told him that he had to be careful as it was rather dangerous. Nothing more was said and he passed on. I next saw him at 12.50 p.m., when he was lying on the stretcher and was being carried away from the line. Several of my men have already received slight shocks from the live rail. In one case a man tripped and fell with his hands on it, and in another case a man had his arm burned whilst fixing an insulator. We have had a good many complaints of late from our men as to the danger of the live rail. These complaints have mostly been received since the accidents have occurred. As regards the wood guarding, the men complain that they get shocks from it and that it interferes with their work, but none of the men have been at all hurt by the shocks which they have received through the wood. Since we have been regularly running we have had no case of the shoe fouling the wood. There have been several cases of my men receiving slight shocks, but not sufficiently severe to necessitate artificial respiration.

Mr. C. H. Merz states: I am electrical consulting engineer to the North-Eastern Railway Co. The question of protection has been one of the matters which have been continually in view from the carrying out of the work, and it has been recognised that it is one of these matters upon which there would be considerable difference of opinion among the various men engaged on the railway. The conditions to be met and the type of ballast differ considerably from that in use in other places, and the form of protection which would not only be most efficient but which would interfere as little as possible with the work which had to be done on the railway could not be settled from a mere discussion of drawings, but it was recognised would depend largely on practical experience. Until the time of this accident considerable parts of the line had been alive, but not in the neighbourhood of the central station except for experimental purposes on Sunday mornings and such times. The line therefore had not been alive to any great extent at complicated junctions or crossings. Numerous discussions on every suitable occasion were held between myself and my assistants and the various officials of the railway company, and the general impression created in my own mind as the result of the experience on the pieces of line which had been alive, and which, as I have said, were chiefly in the open and not at complicated junctions, was that the protection was not thought very much of by the men actually engaged in the work. In fact, it has several times been stated they would rather do without it. Now that the whole line is alive and is working under practical conditions, other things have been brought forward; for instance, the case of shunters and men who have not actually to deal with the permanent way work, and I think that perhaps at the present time there is a tendency for everyone's opinions to rather change daily with the latest incident that arises—that is to say, I do not think that anyone's opinions are very definite, or that they can consider them conclusive or final on this question of protection. I think the railway company are desirous of putting up protection as soon as possible at any places where it is really necessary, but in doing so they are anxious, and I am most anxious, that it should be put up of the most efficient type; and with the view of finding the most efficient and convenient type, several designs are in use at the present time, and others are being tried. One special point which is receiving attention at the present moment is the width between boards. It is obvious on looking at the protection itself that it is more efficient the narrower the distance between the boards, but this involves very careful consideration and practical experience as to the variation and position of the shoe under working conditions. Certainly, my own opinion and the opinion of the permanent way people at present, so far as I have been able to discover it, is that the road will be more difficult to keep in order the more protection there is. Probably, so far as working on the road is concerned, temporary guards or rubber mats or insulated tools would be of more use than guard planks. In fact, the permanent way men consider it most desirable that protection should be made removable, and if it was made removable, and were removed in the case of working on the line, it would, of course, be of no use as protection to those particular men. Broadly, the two distinctive types of protection are a type supported from the sleeper, and a type supported from the rail. The difficulty in regard to the type supported from the rail, is that in wet weather the woodwork becomes more or less of a conductor, and any iron work certainly takes the potential off the rail as the result of surface leakage and the thorough soaking of all timber with water. The difficulty in regard to the type supported from the sleeper, is that unless metal is used to support the timber it is difficult to make it sufficiently rigid, that it interferes more with the upkeep of the permanent way, and if metal is used for supporting the timber that it brings the metal parts into close proximity to the third rail itself. We have kept in mind throughout the design of the whole work a minimum clearance of 6 in. from the rail to any metal parts in contact with earth, and we should certainly consider it dangerous to encroach upon this minimum distance. I do not think that protection could be done for less than £200 per mile of single track; this provides double guarding. In the present electrification scheme there is not less than 82 miles of single track.

Mr. H. A. Watson states: I am general superintendent of the North-Eastern Railway, and am in charge of the working of the traffic over the lines, including those electrified. The company's directors and officials have been giving very careful consideration to the question of protecting the live rail. We have had representations from our men as to the necessity of protecting parts in addition to those already protected, and we have promised the men that we will protect the rail wherever necessary. Our district superintendent at Newcastle is busy getting out a statement of places where he thinks protection should be given, and he is to consult the men as to whether it meets their wishes. Instructions have already been given for protecting the third rail inside the Central Station. This work is now practically completed. Instructions have also been given for protecting the third rail round about Trafalgar goods station, opposite Manors, where there is a considerable shunting work to perform alongside and across the electrified lines. Instructions have also been given for parts of the line to be fitted experimentally with a new kind of protection, consisting of a single board, and also for parts of the third rail to be painted a bright red experimentally, so as to more readily call the attention of any unwary person to the fact that it is different from the track rails. Two of the three fatal accidents which have occurred have occurred to trespassers. The first case was that of a child three years of age, who was wandering about without any guardian, and had crawled through a fence. In order to guard against similar accidents of this kind, the company are incurring a large expense in fitting a military fence at places where children are likely to be playing about in the vicinity of the rail. The third accident, namely, that on June 29th, happened to a boy who climbed a stone wall 5 ft. high, in order to cross the railway, although there was a safe level crossing and also an underline bridge close by. He had been previously warned, and the lad who was with him at the time of his death stated at the coroner's inquest that he knew of the danger they were running. So far as I am aware, the representations which we have received came from all classes of company's servants. These representations were received through the Secretary of the Newcastle Branch of the Amalgamated Society of Railway Servants. I do not think it would be possible to issue an absolute prohibition against our servants crossing the live rail where it was not protected. So many contingencies arise in working the railway that an absolute prohibition could not be obeyed, but we intend to issue as stringent a regulation on the subject as we think possible. In fact, such a regulation has already

been issued. Our present opinion is that protection of the whole line is unnecessary. All our men know that railway work is to some extent necessarily a dangerous employment, and the instinct of self-preservation ought to be sufficient in many places to avoid accidents without protection. We think that the number of accidents will very soon largely decrease. Of course we are to some extent feeling our way and waiting to be guided by experience. As I have stated above, the guarding is ordered at the spot where this accident occurred, and similar places on the line will be treated similarly. We have issued a special rule book in connection with the working of the electrified lines, and Rule No. 7 is as follows:—

> "Trespassing on the lines is a dangerous practice and is strictly prohibited."

In this rule the word "trespassing" applies equally to members of the public and company's employés who do not require to be at the particular place in the execution of their duty. For the protection of men having to walk along the line, as distinguished from crossing it, we have a rule that they must walk in the four-foot way. Rule 6 also deals with the question. It states as follows:—

> "Servants of the company are warned against crossing the third rails more than is absolutely necessary in the discharge of their duty."

For the further protection of the men we have distributed india-rubber gloves freely; also rubber mats, &c.

*Conclusion.*

No evidence is forthcoming as to the precise circumstances under which this accident occurred, but there seems no doubt that during his dinner interval porter Innes had crossed the line from the granary to the goods station; in returning he crossed the main lines in safety, but in crossing the Tynemouth lines it appears that he stumbled and fell. In falling, the back of his head seems to have come into contact with the live rail of the up Tynemouth line, while his face came into contact with some point rods passing under the rails at that spot. The electric current from the live rail passed consequently through his head and undoubtedly caused his death.

There is no evidence as to why Innes was crossing the line on this occasion. It was during his dinner interval, so he was not crossing on duty, but the evidence of the company's officials is to the effect that Innes himself and others of the company's servants have necessarily, at times, to cross the lines between the granary and the goods station on duty, and the company do not claim that Innes was doing wrong on this occasion in doing so.

This spot being, therefore, one at which the company's servants habitually cross the line, it is, I consider, essential that precautions should be taken to guard them from danger arising from the live rail, and it is to be regretted that the live rails of the Tynemouth branch had not been guarded similarly to those of the main line.

It is satisfactory, however, to hear, as stated by Mr. H. A. Watson, the general superintendent, in his evidence, that orders have been given for double guarding to be provided for these lines at this spot forthwith, and that at the same time experiments are in progress as to the best form of guarding to be provided. Mr. Watson further states that his company are in consultation with their servants as to what other portions of the electrified line call for similar precautions, and that at all such places it will be provided forthwith.

Special rules have also been issued to their servants in connection with the electrified lines; and for the protection of their permanent way men, india-rubber gloves and mats have been freely issued.

Special notices calling attention to the danger arising from the live rail have also been posted on the electrified portion of the line at all level crossings, at all places where trespass is likely, and at all places where the servants of the company are likely to be working.

The steps now being taken by the company are, I consider, satisfactory, and should undoubtedly tend to lessen the liability of their servants coming in contact with the live rail.

It was noted, however, that at Manors Station it is only at the down end, where there are sidings, that the guarding has been provided, and that the remainder of the lines between the platforms are, with the exception of one spot of only a few feet in length, unguarded. At stations there is always a possibility of the company's servants having to cross the lines, and also a danger of the public accidentally getting on to them. I consider, therefore, that guarding should be provided to all live rails where they pass through stations, and the company's attention is therefore drawn to the advisability of carrying out this further precaution.—I have, &c.,

P. G. von Donop, *Lieut.-Col., R.E.*

I concur with this report.

A. P. Trotter, *Electrical Adviser to the Board of Trade.*

The Assistant Secretary,
Railway Department, Board of Trade.

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North-Eastern Railway.

Board of Trade (Railway Department),
8, Richmond Terrace, Whitehall, London, S.W.
*July 12th*, 1904.

Sir,—I have the honour to report, for the information of the Board of Trade, in compliance with the order of July 5th, the result of my inquiry into the circumstances under which a boy named Jonas Whitehead met with his death on June 29th, when trespassing on the North-Eastern Railway, near St. Peter's Station.

About 5.9 p.m. on the above-mentioned day, Whitehead was found lying across the line about 50 yards on the down side of St. Peter's Station, and there appears to be no doubt that his death was caused by his having come into contact with the live rails used in connection with electric traction on this railway.

*Description.*

St. Peter's Station, near which this accident occurred, is situated on the riverside branch of the North-Eastern Railway between Newcastle and Tynemouth.

The lines through the station are double, and they run through it in directions which are approximately east and west, the down line being on the north side of the line.

These lines form a portion of those which have recently been fitted for electric traction by the railway company, and there are, consequently, two rails, commonly known as live rails, fixed in the 6-ft. way, between the up and down lines. Each of these rails carries an electric current at a potential of 550 volts.

There are on the down side of the station some sidings where shunting is carried on, and for the protection of the company's employés engaged in the work, the live rails at this point have been protected by double wooden guards, but these guards cease on the down side of the station, a short distance from the spot where this accident occurred.

There is, also, about 250 yds. on the down side of the spot where Whitehead's body was found, a footpath level-crossing. At this crossing the live rails are broken, the current being carried across by a buried cable, and the ends of the live rail on each side of the crossing are well guarded by double boarding.

But between the sidings near the station and the level-crossing the live rails are not guarded in any way, and it was on this portion of the line that the accident occurred.

The line is enclosed on each side by a substantial stone wall, varying in height from 3 to 8 ft., and running alongside the south side of the south wall is a footpath which is apparently much used.

There is a subway under the line almost immediately under the spot where the accident occurred. It is understood that there is not a public right of way through this subway, but it is stated that it is, nevertheless, considerably used by the public.

*Evidence.*

Dr. Alfred Herbert Peters states: On June 29th I was called in by the St. Peter's station-master to see the deceased. When I arrived life was extinct. There were burns on the forearms: the left arm more severely so than the right. I consider that death had been caused by a current of electricity. The muscles of the left hand were quite contracted. It was a dry day. The deceased when I saw him was lying alongside the line close to the spot where I believe the accident had occurred. I believe it was about a quarter of an hour after the accident occurred that I saw him. I could see no discolouration. At the time I arrived the company's employés were endeavouring to restore respiration, but I told them to cease doing so as I saw it was hopeless.

George Cooper Lowery states: On the day that Jonas Whitehead was killed I was with him. We had been down together by the riverside catching crabs, and we then wanted to proceed to our homes which were on the other side of the railway. We walked up together to the wall by the side of the railway, and we then both climbed over the wall at the spot pointed out. We then proceeded to walk across the railway, Whitehead being in front of me. I think that Whitehead tried to jump over the first live rail but that he tripped on it and fell across the second live rail. He just moaned but did not say anything. I did not see any flash or flame of any sort. I went up to look at him and I saw him shake and I came away again. There was a man at the time under the bridge, and I looked over the wall and told him. There was a man standing at the time on the bank above the line, and he at once waved his handkerchief to the station-master. I then went away, leaving the boy lying across the line, and I do not know what happened further. I had often crossed the line at this point before, but I have never been across since the live rail was fixed; I knew that there was a live rail there and that it was dangerous. I do not know if the other boy knew that it was dangerous. I have heard of other boys getting slight shocks on the line. As we had been going down to the river that afternoon a man had warned us of the danger of the live rail, but we had not gone across the line in going down to the river. The last time I crossed the line was last summer.

George Edwards, fireman, states: I have been 10 years in the service of the company, during four and a-half of which I have been a fireman. I was on duty on an engine on the line on June 29th. I was at work on an engine which was working a mineral train on the down line from Newcastle to Percy main. When we were near the end of St. Peter's Station platform I noticed an object lying on the live rail some little way in front of us. I called the driver's attention to it. When I saw it we were in motion. I pointed it out to the driver, and we at once applied the brakes and brought the train to a stand. When we reached the object I saw that it was a boy lying across the live rail. Our engine came to rest about 50 yds. beyond him and I then got down from my engine and went back. I found the boy lying across the two live rails. His head was lying over his arm between the live rail of the down line and the track rail of that line. His legs were across the live rail of the up line and his feet were clear of the ground. His body may have been touching the ground between the two live rails, but I do not think that he was touching the ground outside them. I at once lifted him clear of the live rail and laid him on his back in the 6-foot. He appeared to me to be dead. I noticed marks of burns on both wrists and below the knees on both legs. I saw no other marks, and I did not notice any discolouration The guard came and joined me, and we tried to restore respiration.

but it was no use. I sent a porter away for the doctor, who came shortly after I had gone away. It was a dry day. The boy had neither boots nor stockings on, and knickerbockers down to his knee. I lifted the boy up by his jacket, and I did not feel any shock.

Charles Morley, station-master, states: I am station-master at St. Peter's Station, where I have been for 4½ years. On June 29th, at 5.9 p.m., my clerk came into my office and told me that somebody down the line was waving to me to come, and he thought that somebody had got on to the live rail. I at once went down there. When I was close to the spot, I saw the fireman and guard lifting the boy clear of the live rail. When I first got up to him, there seemed still to be life in him, and they started to restore respiration, and I still thought that there was life in the boy. Every time the arms were extended and brought back again, the boy appeared to me to breathe. We went on doing this for about 20 minutes, but the sound grew gradually less, and before the doctor came we felt sure that life was extinct. Meanwhile, one of the clerks had at once run away for a doctor, and Dr. Peters arrived on the scene at 5.20. The doctor then examined him and said that he was dead. The spot where the boy was found is one which people frequently use for crossing the line, and boys especially do so. On June 27th I had to go down three times to frighten boys away from that part of the line. There is a subway under the line at this very point which people can and do use, though there is no right of way for the public. There is also a level public crossing a little way to the east, about 200 yards from the spot where the accident occurred, and at that level crossing the third rail is protected for about 12 ft. on each side of the crossing.

Mr. H. A. Watson states: I am general superintendent of the North-Eastern Railway and am responsible for the working of the traffic over the electrified parts of the railway. The company's directors and officials have given careful consideration to the question of avoiding accidents similar to this one, and in view of the fact that this is a place where trespass seems very common, we are willing to consider the question of taking special steps to prevent it, and so ensure the safety of the public.

*Conclusion.*

A boy named George Cooper Lowery was with the deceased, Jonas Whitehead, at the time the accident took place, and he gives very clear evidence as to the circumstances under which it occurred.

The boys had been down together to the river, which is on the south side of the line, and in returning to their homes, which were on the north side, they climbed the wall on the south side of the railway and proceeded to cross the lines. Whitehead was in front, and Lowery thinks that he tried to jump the first live rail, viz., that of the up line, but that he tripped on it and fell, falling apparently across the two live rails. His body was in that position when he was found a few minutes later by the company's servants, and though steps were taken to endeavour to restore animation, it was ineffectual, and a doctor who shortly afterwards arrived on the scene pronounced him to be dead. The doctor states that death had been caused by the electrical current. The deceased had at the time of the accident no shoes or stockings on.

There is no doubt that the deceased met with his death by coming into contact with the live rail when trespassing on the line.

The point at which the boys climbed over the wall was identified by Lowery; the wall is at that point 5 ft. in height, and there were very distinct footmarks on it, showing that access to the railway is frequently obtained at that point. There were similar marks, too, on the wall on the north side of the line, where Lowery states that they would have climbed over that wall also. It is evident, therefore, from these marks that, in spite of there being a subway, trespassers do frequently cross the line at this point, and this view is confirmed by the evidence of Mr. Morley, the station-master at St. Peter's, who states that people, and especially boys, frequently do so.

I am not prepared—at the present time, at all events—to recommend the Board of Trade to call upon railway companies to guard their live rails continuously. Guarding should not be necessary as far as the permanent way men are concerned, and it undoubtedly considerably interferes with them in the performance of their duties. But at all stations, sidings, signal-boxes, and such places where shunters, porters, signalmen, and other employés of the company may have to cross the lines in the execution of their duties, protection should certainly be provided; and the public should also be efficiently protected at stations and level crossings.

In this case the live rails adjoining the sidings at the down end of St. Peter's Station were already guarded for the protection of the shunters, and at the level crossing 300 yds. on the down side of the station adequate steps had been taken, as described above, for the protection of the public using the crossing. But between the sidings and the level crossing there are no circumstances connected with the line which, in my opinion, call for the provision of guarding, either as far as the public or the company's employés are concerned.

Special notices calling attention to the danger arising from the live rail have been posted on the electrified portion of the line at all level crossings, at all places where trespass is likely, and at all places where the servants of the company are likely to be working.

Considering, however, that the spot at which this accident occurred is one at which trespass appears to have been for some time past very common, I consider that under the altered conditions of the line some steps should be taken by the company to prevent access being so easily gained to their lines. Similar steps should also be taken at any other spots on the line where trespass is common.

I would also recommend that the guarding of the live rails be continued throughout the whole length of St. Peter's Station, which, it was noted, is not the case at present.

The company's attention should therefore, I consider, be drawn to these two points.—I have, &c.,

P. G. von Donop, *Lieut.-Col., R.E.*

I concur with this report,

A. P. Trotter, *Electrical Adviser to the Board of Trade.*

The Assistant Secretary,
Railway Department, Board of Trade.

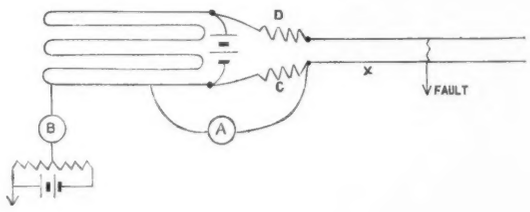
## CORRESPONDENCE.

***Letters received after first post on Wednesday morning cannot appear until the following week.***

### Localisation of Earths.

Referring to Mr. Blaikie's further remarks in your issue of 19th inst., I cannot understand him thinking that any of my results published were not what I said they were, viz., the direct results of testing by the method which I published. The ground was in no case opened anywhere until the fault had been located, and the spot where the ground was opened was where the fault was found in each case. On a straightforward job it is possible, from the time the men leave the works, to locate the fault accurately in two hours, the men employed being the mains foreman, the jointer, and his mate; from this, I think, Mr. Blaikie can make a comparison of the cost of the two different systems, which will speak for itself.

Mr. A. J. Howard raises a point which I think will be perfectly clear to everybody, viz., the possibility of localising a short on a concentric cable by testing from one end only, without the use of an independent return cable. The system employed at Tunbridge Wells is as follows:—




The bridge is connected as before in my fig. 1, with the exception that between the cable under test and the terminal of the bridge, resistances C and D are interposed. The resistance C is, for convenience, equal to 100 yds. of ·1; this is, of course, equivalent to 60 yds. of ·06, &c. The cable is not shorted at the far end, but the short at the fault between inner and outer is sufficient. The first test is taken with the galvanometer in the position B; this gives the equivalent on the bridge to, say, 100 yds of ·1, or 60 yds. of ·06, as the case may, according to the size of the cable under test. The second test is taken with the galvanometer to earth; this will give a length on the bridge which is equivalent to 100 yds. of ·1 + X, the distance of the fault. The distance of the fault, X, will work out to $100\frac{(B-A)}{A}$, assuming the area of the cable to be ·1 sq. in; A and B being the first and second readings taken on the bridge. The resistance, D, may be necessary in some cases, but not always, as an aid to accuracy.

It will be noticed in the above tests that the fault is taken to consist of a short and an earth, this being the most common fault on concentric cables; should, however, there be no earth, the inner or outer cable (not both) should be earthed at the far end, the outer for preference; the fault will then be shown up as if the earth were at the same spot as the short.

I cannot lay too much stress on the importance of keeping mains in a thoroughly good state, for if the insulation is allowed to become bad at three or four places, it is, in my opinion, next to impossible to get any satisfactory results when a bad fault comes along, in the way of locating it.

I have not often found it the case, that it is possible to repair a fault without jointing in extra cable, as even if a fault has only just developed, it is probable that damp has got into the cable, and run along it for some distance.

I do not think Mr. Howard's arrangement, as sketched, would be so accurate as the one I have recommended.

Mr. Hammett's suggestion should give good results, providing the resistance of the cable is known very accurately per yard; but, in my opinion, each of these systems involves a great deal of calculation, which is better avoided.

**Horace Boot,**
*Consulting and Resident Engineer.*

Tunbridge Wells, *August 20th*, 1904.

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### The Telegraph Deficit.

The writer of the article on the above subject in last week's ELECTRICAL REVIEW has evidently not studied the annual returns to Parliament dealing with the finances of the Post Office telegraphs. There are three of these returns, apart from the Postmaster-General's annual report, and they deal very completely with the capital and annual expenditure of the Post Office telegraphs. The figures they contain differ widely from those given in your article of last week.

The total capital expenditure on the purchase of the telegraphs was £10,948,173. The greater part of this, that is, more than £10,000,000 was spent previously to the end of 1874, and the capital account was apparently closed in 1876. There were, in 1870 and 1871, out of surplus balances, and in 1891 and 1899, out of other balances, purchases and cancellations of stock amounting to £80,529, leaving the capital account at £10,876,644, at which amount it stands to-day. The annual interest at $2\frac{3}{4}$ per cent. is £298,860.

It is shown in these returns (Parliamentary Papers, Nos. 295 of 1902, and 2 and 49 of 1904) that the Post Office telegraphs have in two years only presented a sufficient balance of revenue over expenditure to meet in full the interest on the capital, and those two years were 1870 and 1871, the first two years of State control. It is also shown that since 1884 the actual expenditure has exceeded the actual receipts in every year except 1889, 1890, and 1891, in which years there were small balances to the good.

Even this remarkable record hardly prepares one for the astounding deficiency which has been rolled up in 33 years of State management of the telegraphs. This total deficiency is shown by the return to be no less than £10,831,920 at March 31st, 1903. Adding the deficiency for this year, given in the Fiftieth Report of the Postmaster-General as £1,282,541, the total deficiency of receipts to meet expenditure and interest for 34 years becomes £12,114,461.

During this period, expenditure on sites and buildings and on telegraph extension has not been charged to capital. The total expenditure of this sort, really in the nature of capital expenditure, for the same period of 34 years has been £6,300,715. Deducting this from the total deficiency, there is a net deficiency on interest and working charges of £5,813,746 for the 34 years.

These figures show that the total capital account should stand at about £17,000,000. Interest on this at $2\frac{3}{4}$ per cent. would be £467,000. The fiftieth report shows that there was a net loss on the year's working, for the year ending March 31st, 1904, of £301,000, exclusive of capital expenditure. In comparison with commercial conditions, then, the Post Office Telegraphs were operated last year at a loss of £768,000.

**Scrutator.**

*August 22nd*, 1904.

[Our correspondent supplies us with some interesting figures, which we are glad to publish as supplementary to our article of last week, though we fail to see that they furnish any grounds for the gratuitous assumption that we are unfamiliar with the returns to which he refers. In his anxiety to show our inaccuracy, "Scrutator" states that "the total capital expenditure on the purchase of the telegraphs was £10,948,173." This is a form which has become stereotyped even in Postmaster-Generals' reports. It was one of the objects of our article to draw attention to the fact that this stereotyped phrase was not accurate. The 10 millions was not the purchase price, but the purchase price plus subsequent expenditure. In official returns there is an "&c." following "telegraphs" which our correspondent, in conformity with very general practice, has omitted. The "&c." is not unimportant. As mentioned in our article, the actual purchase price of the telegraph companies was stated by Sir William Preece to be £4,989,048. We infer that it is these figures which our correspondent describes as inaccurate, though we note that he omits to supply others in their place. "Scrutator" is quite correct in stating that the capital expenditure, substantially as it now stands, was reached in a very few years after the transfer. Our brief summary of Sir William Preece's statement of facts, as distinct from his expressions of opinion, has probably been misunderstood by our correspondent. Sir William Preece did not say, and we had no intention of implying, that this capital expenditure had only been reached at a much later date, but we think it is possible to draw such an inference from our brief summary, and in justice to Sir William Preece we hasten to correct it. We did not attempt on that occasion to give a complete analysis of the Telegraph Accounts. We only desired to draw attention to two essential features which we consider of such importance as to take this opportunity of repeating them, viz., (1) the very general impression that 10 millions was the purchase price of the telegraph companies is erroneous; and (2) the criticisms of the working of the Telegraph Department, which we quoted, and those of a like nature based on comparisons with similar undertakings on a commercial basis, or with the postal service, are unsound. In the latter we have clearly our correspondent's support, though we possibly differ in the inferences which may, for practical purposes, be drawn from the facts.—EDS. E.R.]

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[A correspondent wants particulars of any apparatus on the market for the automatic regulating of a dynamo direct driven from a water turbine.]

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## THE NEW BOARD OF TRADE REGULATIONS.

SINCE the Board of Trade issued their Regulations in 1896 (under the Electric Lighting Acts, 1882 and 1888) for securing the safety of the public and for securing a proper and sufficient supply of electrical energy, many alterations and new conditions in connection with electrical supply have been adopted. In particular, an almost universal conversion from so-called low pressure to high pressure at consumers' terminals has taken place, whilst power supply has also become very general. In consequence, the necessity of amending the above Regulations has commended itself to the Board of Trade, and a draft set of new Regulations has been prepared for consideration; these comprise:—

1. L.A.P. (Local authority undertaking in the provinces).
2. C.P. (Company undertaking in the provinces).
3. C.L. (Company undertaking in London).
4. L.A.L. (Local authority undertaking in London).

As these codes do not differ largely from each other, we shall, in commenting on the alterations and additions, consider them altogether, merely pointing out the differences when they occur, as if they were taken separately a large amount of repetition would be unavoidable.

*Definitions.*—The first alteration to be noticed is in the definitions of supply pressures. Originally 500 to 3,000 volts on continuous current systems, and 250 to 3,000 volts on alternating current systems, were deemed high pressure supplies; and above 3,000 volts on either system, extra-high pressure supply. We now find the following definitions:—

| | | |
|---|---|---|
| Low pressure supply | ... | up to 250 volts |
| Medium „ | ... | 250 to 650 „ |
| High „ | ... | 650 to 3,000 „ |
| Extra high „ | ... | over 3,000 „ |

A.—Regulations for Securing the Safety of the Public.

*General.*

In the 1896 Rules, Clause 1 specifies that the pressure of supply delivered to any consumer shall not exceed 250 volts, except with the express approval of the Board of Trade, such approval being only given for special purposes and on the joint application of consumers and undertakers, whilst further regulations may be prescribed. In the new regulations the same limitation is made as regards pressure, but for special purposes "it may exceed the limit of low pressure but not the limit of medium pressure on the consumer undertaking to comply" with certain conditions.

As the latter are very important, we cannot do better than quote them in their entirety.

(*a*) Where the supply is for power purposes—

1. The frame of every electric motor shall be efficiently connected with earth.

2. The consumer's wires forming the connections to motors, or otherwise in connection with the supply, shall be, as far as practicable, completely enclosed in strong metal casing efficiently connected with earth, or they shall be fixed at such a distance apart, or in such a manner, that there shall be no danger of any shock.

3. The supply to every motor shall be controlled by means of an efficient cut-off switch, placed in such a position as to be easily handled by the person in charge of the motor, and connected so that by its means all pressure can be cut off from the motor itself, and from any regulating switch resistance or other device in connection therewith.

4. Switches, efficient fuses, or other automatic cut-outs shall also be provided, so as to protect the circuits from excess of current and all switches and cut-outs shall be so enclosed and protected that there shall be no danger of any shock being obtained in the ordinary handling thereof, or of any fire being caused by their normal or abnormal action.

5. A notice shall be fixed in a conspicuous position at every motor and switchboard in connection with the supply, forbidding unauthorised persons to touch the motors or apparatus.

(*b*) Where the supply is for arc lamps in series—

1. The consumer's wires forming the connections to the arc lamps, or otherwise in connection with the supply, shall be, as far as practicable, completely enclosed in strong metal casing efficiently connected with earth, or they shall be fixed at such a distance apart or in such a manner that there shall be no danger of any shock.

2. The supply to every arc lamp shall be controlled by means of an efficient cut-off switch, placed in such a position as to be easily handled by the person in charge of the arc lighting, and connected so that by its means all pressure can be cut off from the arc lamp itself, and from any regulating switch resistance or other device in connection therewith.

3. Switches, efficient fuses or other automatic cut-outs shall also be provided, so as to protect the circuits from excess of current, and all switches and cut-outs shall be so enclosed and protected that there shall be no danger of any shock being obtained in the ordinary handling thereof, or of any fire being caused by their normal or abnormal action.

(*c*) Where the supply is for incandescent lamps in series—

1. The consumer's wires forming the connections to the incandescent lamps, or otherwise in connection with this supply, shall be completely enclosed in strong metal casing, and this casing, together with the switches and lamp-holders, if metallic, shall be efficiently connected with earth.

2. Switches, efficient fuses or other automatic cut-outs shall also be provided, so as to protect the circuits from excess of current, and all switches and cut-outs shall be so enclosed and protected that there shall be no danger of any shock being obtained in the ordinary handling thereof, or of any fire being caused by their normal or abnormal action.

Where the supply is for any special purpose other than those above mentioned, or where the pressure of the supply exceeds the limits of medium pressure, it shall be subject to such other regulations as the Board of Trade may from time to time prescribe.

*(To be continued.)*

## THE BRITISH ASSOCIATION MEETING.

The fourth Cambridge meeting of the B.A. came to an end on Wednesday, and, both in point of numbers in attendance, and in regard to the interest and importance of the papers read, it will rank as the best gathering that the Association has had for some years past. The presence of the Prime Minister, the convenient situation of the place of meeting, and the peculiar connection of Cambridge as a city of learning and of education with scientific research, were among the factors which led to more interest being taken in the proceedings than has sometimes been the case with the congresses of recent years.

The proceedings in the "Engineering" Section (G), and also those of the Mathematical and Physical Science Section (A), opened on Thursday morning, August 18th. A crowded audience assembled to hear the Hon. C. A. Parsons deliver his interesting presidential address in the former section on invention and the hardships of inventors, and the illustration which he produced respecting boring to great depths was followed with great pleasure by his hearers. Some may have felt that the case put forward was rather an extreme one, and not calculated to afford the most convincing argument in favour of urgent and drastic patent law reform; but the illustration answered the purpose of the sectional president, which was to bring out in such a way as to appeal to the mind of the general public the loss which we may be sustaining by the negligent treatment which we, as a nation, mete out to the inventor.

Mr. A. J. Balfour moved a vote of thanks to Mr. Parsons for his address, and said that the patent laws of various countries presented subjects of the greatest difficulty. He doubted whether we should ever have a perfect system of patent laws in any country until the community of civilised nations had come to some common agreement as to how things were going to be managed. The agreement of civilised nations was a plant of slow growth, but not an unhealthy one. He did not think that a modification of our patent laws would ever induce any pioneer to bore to a depth of 12 miles for 85 years. The history of inventors was, on the whole, a pathetic one, but the president of Section G at least had lived to see his inventions recognised throughout the civilised world as of immense value, while he had also enriched the world. Our great scientific neighbours in Germany desired to express their recognition of Mr. Parsons's labours in the development of the steam turbine, and Prof. Schroter was the bearer of the Grashof medal voted by the German Society of Engineers.

The Professor, in a most courteous address, then presented the gold medal and diploma to Mr. Parsons on behalf of what he said was the largest engineering society in existence, its membership being 19,000. Mr. Parsons, in briefly responding, said that, when he first commenced to work upon the steam turbine, there were at least 100 patents in the Patent Office of which they did not know, some of them almost identical with the work that they commenced upon, and it was not until six years later, in a lawsuit, that they were annulled. The first thing that led him to work in this direction was seeing Sir Charles Wheatstone's tiny mirror revolving at 15,000 r.p.m. That gave him the first idea to run at sufficient velocity to get efficiency from the steam turbine.

Friday morning was chiefly given up to a discussion on the following papers:—Mr. E. Dugald Clerk, on "Flame Temperatures in Internal Combustion Motors"; Prof. H. B. Dixon, on "The Specific Heats of Gases at High Temperatures"; Prof. B. Hopkinson, on "Exhaust Gas Calorimetry." Other papers taken the same morning were on "The Effect of Receiver Drop in a Compound Engine," by Mr. J. W. Hayward; and "Superheated Steam: Throttling and Other Experiments," by Mr. A. H. Peake. The following is a list of the other electrical papers which came before G, and which will be referred to in later issues of the Electrical Review:—

"Electricity from Water-power," by A. A. Campbell Swinton.

"The Use of Electricity on the North-Eastern Railway and on Tyneside," by C. H. Merz and W. McLellan.

"Energy Losses in Magnetising Iron," by W. M. Mordey and A. G. Hansard.

"The Hopkinson Test as applied to Induction Motors," by Dr. W. E. Sumpner and R. W. Weekes.

"Distribution of Magnetic Induction in Multipolar Armatures," by W. M. Thornton.

"Large Bulb Incandescent Lamps as Secondary Standards of Light," by Prof. J. A. Fleming.

"Some Investigations on the 10-c.p. Harcourt-Pentane Lamp made at the National Physical Laboratory," by Clifford Paterson.

"The Production of Magnetic Alloys from Non-magnetic Metals," by R. A. Hadfield.

"An Electric Temperature Alarm," by H. Darwin.

"The Electrical Conductivity of Certain Aluminium Alloys as affected by Exposure to London Atmosphere, and a Note on their Micro-structure," by Prof. E. Wilson.

"Testing Alternating-Current Motors by Direct Current," by W. Cramp.

"The Action of Lightning Strokes on Buildings," by Killingworth Hedges.
"A New Process for the Protection of Iron and Steel from Corrosion," by S. Cowper-Coles.

The following is a list of some of the subjects which were brought before Section A during the meetings :—

"The Reaction of the Radiation on a moving Electron," by Prof. M. Abraham (Göttingen).
"On the Relation of Röntgen Rays to Ordinary Light," by Prof. J. Larmor.
Discussion on "N" Rays, opened by Dr. O. Lummer.
"Recent Work of the National Physical Laboratory," by Dr. R. T. Glazebrook, F.R.S.
Report of Committee on Electrical Standards.
"On the Effect of Electrical Oscillations in Optically Active Bodies," by Prof. W. Voigt (Göttingen).
"Electric Waves along Spiral Wires, and applications to Wireless Telegraphy," by Prof. J. A. Fleming, F.R.S.
"Magnetic and Electric Properties of Nickel at High Temperatures," by Prof. C. G. Knott.
"Eddy Current Losses in the Lead Sheaths of Three-Phase Cables," by M. B. Field.
"Magnetic Double Refraction of Colloidal Iron Hydrate," by Dr. A. D. Denning.
"On the Electric and Thermal Conductivities of certain Alloys of Iron," by Prof. W. F. Barrett, F.R.S.
"A new Apparatus for Producing Magnetic Fields of Force," by Prof. M. Hartog.
"A probable Cause of the Annual Variation of Magnetic Storms and Auroræ," by Dr. W. J. S. Lockyer.
"A Correlation between the Electric Conductivity of Air and the Variation of Barometric Pressure," by J. Don.
"On the Ionisation of the Atmosphere," by Prof. A. Schuster.
Discussion on the Radio-activity of Ordinary Matter, opened by Prof. J. J. Thomson, F.R.S.
"Properties of Radio-active Minerals," by Hon. R. J. Strutt.
"Radio-activity of the Hot Springs of Aix-les-Bains," by Dr. G. A. Blanc.
"Plan of a Combination of Atoms to have the Properties of Polonium or Radium," by Lord Kelvin.
"Electrical Insulation in Vacuum," by Lord Kelvin.
"Electrical Conductivity of Flames," by Dr. H. A. Wilson.
"Electrical Properties of Hot Bodies," by Dr. O. W. Richardson.
"The Production of Radio-active Surfaces," by C. E. S. Phillips.
"The Kinetic Theory: Determination of the Size of Molecules," by J. H. Jeans.
"On the Energy of Steam and Water at High Temperatures," by Prof. C. Dieterici.
"Dr. Grindley's Experiments on Steam in the Light of the Ether Pressure Theory," by J. Macfarlane Gray.
Address by Prof. J. H. Poynting, F.R.S., on Radiation in the Solar System.

Next year the meeting of the British Association will be held in South Africa, with Prof. George Darwin as president. In 1906 the Association will meet in York.

## WHERE IS THE PLACE OF UNDERSTANDING?

THE gently ironical address by the Prime Minister to the British Association at Cambridge puts once more the question of the nature of knowledge, and his text was the change in our mental attitude, now that we perceive matter to consist of an aggregation of strain centres in the ether. The idea which has led to this is, of course, not new. We do not know how old it may be, but the recent work of Larmor and the experiments of Crookes, Thomson, the Curies, Rutherford and others have brought a philosophical speculation to be a generally adopted view. M will disappear from dimensional formulæ, and with advance of knowledge, all physical quantities will be stated, and stated completely, in terms of space and time, two purely intellectual conceptions, independent of sensual experience.

Sir William Hamilton's demonstration of the difference in kind of vectors in different directions, and of the meaning of multiplying together two things of different kinds, led directly to a correct conception of physical dimensions. What idea could Locke have formed of multiplying mass by length and dividing it by time, a conception so familiar now that one loses sight of its novelty? Sir Arthur Rücker and his pupils, in convincing us that a physical quantity is really defined by its dimensional formula, took another step forward.

Mr. Balfour treats as an accepted fact, that the philosophical intellect is an accidental bye-product of the operation of natural selection, and asks how our capacity for knowing the universe, conditioned as it is by the limitations of such a process, can be trusted to take impressions corresponding in the slightest degree with any external fact.

Surely the answer is that the external world is a crude misconception. With matter a local accident of the ether, and the ether a function of space and time, *i.e.*, of pure intellectual conceptions, or modes of thought, or whatever else we call them, we must agree with Berkeley that except the mind there is nothing to know. The advance of science is the advance of intellectual analysis. The mechanism and laws of nature are the mechanism of the mind and the conditions of its operation, *i.e.*, of thought; and physical science is as much a branch of metaphysics as are pure mathematics or theology or chess. The branches, it is true, differ greatly from one another in the extent to which we are able to obtain new combinations and conditions for contemplation, and advance in mental analysis is most easily made in those branches in which what we term experiment is possible. At the same time advance is possible in others. Metaphysicians will claim that Hegel and Green have enormously developed their subject. Cayley and Fermat were largely independent of any physical discovery or experiment, and we suppose Dr. Rashdall's essay in "Contentio Veritatis" to be a substantial advance in a certain direction in Christology.

We find that the mind operates along certain lines and in certain ways. Some of these have been discovered and closely surveyed, and have received names and been mapped out; such are the gravitation of matter, the conservation of energy, the Pythagorean Theorem. Others have been perceived, but cannot yet be exactly defined. The distinction between the noble and the ignoble, between matter which is alive and that which does not live, the laws of prime numbers, and the nature of a man's duty to his parents, are metaphysical problems waiting for exact solution. The problems of eschatology, and of the existence of the universal mind, may yet succumb to experiment, and seem to be hardly further from our reach than the ultimate constitution of matter would have seemed to Bacon or to Locke.

## REVIEW.

*Refuse Disposal and Power Production.* By W. Francis Goodrich. London: Constable & Co. 16s. net.

In the preface to this work, Mr. Goodrich tells us that he places sanitation in the fore-front as the primary object of the destructor, relegating the production of power to a very secondary place, no matter how valuable an asset such power may be.

He, however, recognises that the zeal of the average town councillor in matters of sanitation is short-lived, if improved sanitary conditions, resulting from a refuse destructor, mean an addition to the rates, and arrives at what, at first sight, seems a somewhat paradoxical conclusion, viz., that the striking financial success achieved in some towns, where the power produced by the destructor is put to such useful purposes as sewage pumping, or the generation of electricity, discourages its adoption in other towns where no commercial application of the power is to be looked for.

There can be no question but that the possibilities in the way of power production by destructors have had considerable influence in popularising this method of disposing of town's refuse, and Mr. Goodrich shows no small amount of business acumen in adding the words "Power Production" to the title of his book.

Notwithstanding the author's preface, we find that "power production" looms very large on the first page, and occupies really a considerable portion of the contents. We do not complain of this, as a large number of data are given, compiled from actual tests and records, from which the reader may deduce his own conclusions.

Chapters II. and III. deal respectively with refuse tipping on land and at sea, and it is in dealing with this part of the subject that the author lets himself go; in more than one

place we read: "Many a lovely landscape is blighted by an unsightly, evil-smelling, dangerous heap of decomposing filth." "Why," asks the author, "in the name of common sense, should the hoarding of filth be reduced to a fine art? Why devote study to a system which, generally speaking, stands condemned from Dan to Beersheba, a system which can never be final, and which was recognised as an impossible one even before the Christian era?" It is not so long ago that the author thought it necessary neither to go back more than about 30 years in the history of refuse destruction, nor to go so far afield as Palestine for evidence; but he appears to have since received special information from the latter quarter. Beersheba has, however, been in ruins for a very long time, and as for Dan, well, as it is in the land which is always associated in one's mind with milk and honey, one can readily believe that refuse tips would be "taboo" in that region.

The author seems to have a special grudge against the muck-fly. He generally drags it in. Surely it cannot be a question of trade rivalry. The fly in its humble way performs the work of refuse destruction just as surely as does the modern destructor furnace; and, if it *does* occasionally carry disease from the refuse tips, we must not forget how much more it has prevented, nor that there are complaints sometimes as to the smell from the destructor chimney.

Two chapters are devoted to descriptions of destructors and methods of charging. The descriptions are clear, and cover most of the types now in use. Many of these have been already described in the ELECTRICAL REVIEW, and do not, therefore, call for further comment here. The text is amply supplemented by illustrations, and the *pros* and *cons* of top, back, and front feeding are fully discussed. The author prefers the method of front feeding by shovel, that is, for ordinary ash-pit refuse. Referring to the use of hot air for the furnaces, we learn, from p. 67, that experiments have shown that, with very wet refuse, the fires would die out when cold air was supplied to the blowers, but with air heated to 300° F. rapid combustion could be maintained.

The labour cost in connection with destructors is a very important item. It is generally claimed that refuse as a steam raiser is equal, on the average, to one-fifth of its weight of good steam coal. Obviously the cost of stoking refuse is, on this basis, five times the cost of stoking coal, even assuming the clinkering to be the same per ton of fuel.

The author does not favour piecework or bonus systems unless the supervision is of the best. It tends to "rushing" the fires, with the result that the clinker is too soft for utilisation, and is also very offensive. A given weight of refuse requires for its proper treatment a certain period of time in the furnace, and one defeats the primary object of the destructor by offering incentives to "rush" the refuse through quickly.

The average costs per ton for labour are given as follow:—Top-feed systems; an average of 85 installations works out at 13·54d. Mechanical charging systems; the average of nine installations is 14·83d. Shovel or hand feed; the average of 25 installations gives 1s. London and district; the average of 12 installations works out to 16·01d. A long table of costs in different towns is given, from which it is seen that the figures range from 6¾d. to 2s. 10d. per ton, the lowest cost being in connection with hand firing.

Dealing with combined destructors and electricity works, the author believes that much of the opposition on the part of station engineers to combined stations is due to the feeling that a destructor is not altogether a pleasant adjunct—a feeling we are inclined to share with them.

It is admitted that the steam pressure in refuse-fired boilers cannot be maintained so constant as with coal-fired boilers, and the author advocates the use of reducing valves between the boiler and the main steam header, allowing for a margin of, say, 40 lbs. between the two. This method works very satisfactorily at Darwen, where the boiler pressure is 200 lbs. per sq. in., reduced to 140 lbs. at the engines.

A list of 20 combined stations is given, from which we see that the number of B.O.T. units generated per ton of refuse consumed ranges from 15 to 80. The latter is the figure for Warrington, with a Meldrum top-feed destructor dealing with 50 tons of refuse per day. The period of time covered by this average figure is not given, and it would be interesting to know whether it is a test result or a regular working output.

It is impossible, in the space at our disposal, to do more than mention many of the points dealt with in this book, such as the disposal of residuals, special points in design to secure high temperature and steady steaming, the best types of boiler, &c.; all these are lucidly treated, the author freely criticising everything in modern practice which does not coincide with his own views, which are vigorously expressed. There are close upon 400 pages of letterpress, including 98 illustrations, and while we may consider the author a little prolix here and there, we do not hesitate to say that the work is a useful addition to the literature on the subject, and contains many valuable data not to be found in collected form in any other book with which we are acquainted.

The author, as usual, gives a very complete index.

## BUSINESS NOTES.

### Electrical Wares Exported.

WEEK ENDING AUGUST 25TH, 1903.

| | |
|---|---|
| Alexandria | Value £164 |
| Amsterdam | 65 |
| Antwerp | 230 |
| Auckland | 210 |
| „ Elec. fuse | 70 |
| Bahia | 40 |
| Bombay | 65 |
| Bremen | 21 |
| Brisbane | 80 |
| Buenos Ayres | 126 |
| Calcutta | 89 |
| Cape Town | 1,044 |
| Channel Islands | 55 |
| Chemulpo | 90 |
| Colombo | 80 |
| Durban | 4,038 |
| Fremantle | 474 |
| Gothenburg. Teleg. mat. | 42 |
| Hong Kong | 43 |
| Madras | 201 |
| Melbourne | 40 |
| „ 9 tons Teleg. wire | — |
| New York | 25 |
| North Atlantic. 81 knots Teleg. cable | — |
| Otago | 128 |
| Perth | 178 |
| Port Elizabeth | 351 |
| „ Teleg. mat. | 1,851 |
| Rosario | 84 |
| Shanghai | 298 |
| Stockholm | 21 |
| „ Teleg. mat. | 25 |
| Sydney | 3,068 |
| „ Teleg. mat. | 698 |
| Yokohama | 49 |
| Total | £14,215 |

WEEK ENDING AUGUST 23RD, 1904.

| | |
|---|---|
| Alexandria | Value £50 |
| „ Teleg. mat. | 940 |
| Amsterdam | 35 |
| Auckland | 262 |
| Bangkok | 100 |
| Bombay | 66 |
| Buenos Ayres | 161 |
| Calcutta | 2,569 |
| „ Elec. machinery | 213 |
| „ Telephones | 35 |
| Cape Town. Elec. machinery | 650 |
| Colombo. Elec. machinery | 22 |
| Demerara | 22 |
| Durban | 509 |
| „ Elec. motors | 241 |
| East London. Elec. machinery | 539 |
| Fremantle | 121 |
| Hamburg | 89 |
| Hong Kong | 248 |
| „ Teleg. mat. | 233 |
| Madras. Elec. machinery | 47 |
| Melbourne | 95 |
| New York | 20 |
| Ostend. Elec. machinery | 30 |
| Otago | 76 |
| „ Elec. machinery | 137 |
| Penang. Elec. instruments | 21 |
| Perth | 23 |
| „ Elec. instruments | 70 |
| „ Teleg. mat. | 16 |
| Port Elizabeth | 182 |
| Rio Janeiro | 220 |
| Rosario | 106 |
| Saigon | 33 |
| Seychelles. Teleg. apparatus | 65 |
| Shanghai | 481 |
| Singapore | 19 |
| Sydney | 652 |
| Tokio. Elec. cable | 2,890 |
| „ Elec. tramcar equip. | 2,599 |
| „ Teleg. mat. | 367 |
| Wanganui | 55 |
| Wellington | 75 |
| Yokohama | 16 |
| Total | £15,410 |

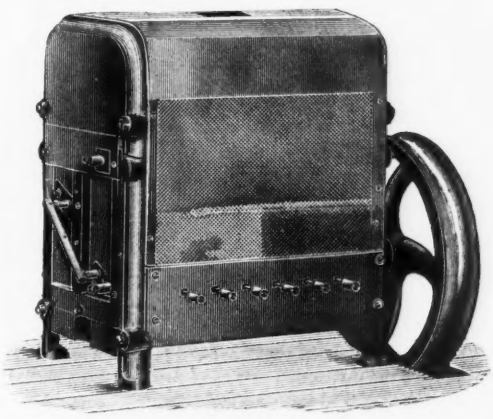
### Foreign Goods Transhipped.

| | |
|---|---|
| Otago. Telephones | Value £45 |
| Durban. Elec. goods | Value £171 |
| Napier. Telephones | 18 |
| New Plymouth. Elec. mach'ry | 420 |
| Paris. Elec. machinery | 102 |
| Shanghai. Elec. goods | 50 |
| Sydney. Elec. lamps | 10 |
| Total | £771 |

**Replaceable Rail Tread.**—A protected replaceable rail tread has been in use for some time past on the curves of the Isle of Thanet Electric Tramways, and has been found very successful. The curves on this company's lines are very sharp and numerous, and heretofore it has been found necessary to renew them about every 12 months. It has been found that when the skin of the rail has been worn through, the rails are quite soft, and wear away very quickly. Mr. Humphries, engineer and manager to the company, has designed a rail to overcome this difficulty. A piece of rail of 6 in. section is taken, sufficient for the outer rail of the curve, and is plated with 6-ft. lengths of 2 in. × ⅝ in. double shear steel, which is extremely hard and of even nature all through. This is fixed to the head of the rail by means of counter-sunk steel screws, 9 in. apart, the heads being flush with the head of the rail, and the nuts underneath. The whole of this is fixed up to the ordinary 6⅝-in. rail, thus making the running face level, and giving a curve of an extremely hard nature on the curve, also raising the wheel flange above the check of the outer rail, which, in itself, is a great advantage on a sharp curve. On the inner rail an ordinary section is used with a check about ¼ in. high, and a good wide groove. We are informed that cars take these curves without noise or grinding, and it will be a great advantage to be able to renew the curves without taking out the whole of the rail and road-bed. All that will be necessary will be to put in new pieces of shear steel 2 in. wide and ⅝ in. thick, and this can be done without disturbing bonds or fish-plates.

**Electric Lift and Crane Controllers.**—We have recently had brought before us a controller, manufactured by the Auto-Controller and Switch Co., of Bermondsey Wall, S.E., which is claimed to fulfil all the requirements essential to the proper control of electro-motors. This controller is especially suitable for lift and crane work, as it disposes of many difficulties hitherto experienced.

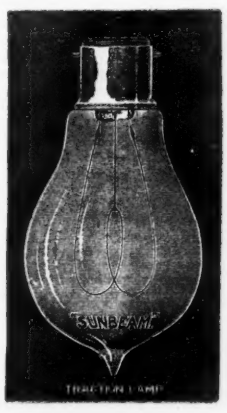
The "Auto-Standard" controller will not cut out any resistance until the motor actually starts, thus effectually safe-guarding the armature of the motor. It, however, differs from other types which possess this feature, in that the cutting out operation is not effected by a positive drive from the motor shaft, necessitating the controller being in the vicinity of the motor, but is operated by electric means and, in consequence, the controller is adapted to be placed in any position most convenient to the person installing the lift.



The Auto-Standard Electric Lift Controller.

The Auto-Controller and Switch Co. have devoted considerable attention to the improvement of electrically-driven hauling and lifting machinery, and claim to have produced a perfectly automatic and reliable controller, which makes it possible to place a crane of this type in inexperienced hands without incurring the risk of injury to the motor, the resistance being cut out automatically in every instance. Other specialities introduced by the firm, are a simple and comparatively inexpensive "push-button" attachment for electric lifts; a combined switch and fuse, enclosed so that a personal injury cannot be sustained; and an automatic electric door lock, specially adapted for the protection of lift openings, &c.

**Traction Lamps.**—We append a few particulars of the Sunbeam Lamp Co.'s new traction or car lamp. It is claimed that the lamp is well adapted for traction purposes, the filament being strongly stayed or supported to withstand the heavy vibration to which such lamps are invariably subjected. We understand

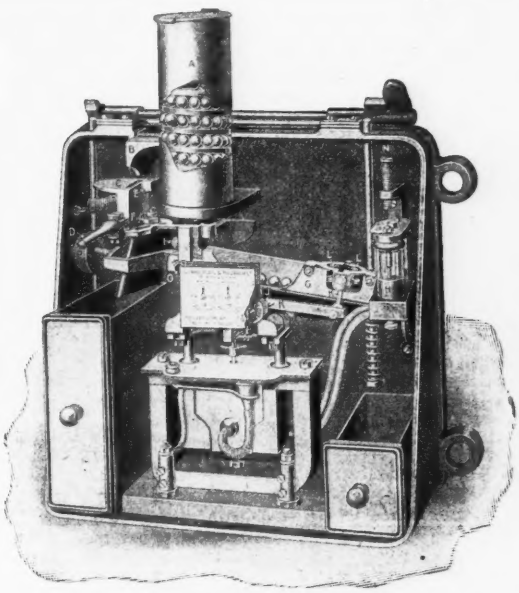



that the lamp is meeting with great favour, and in addition to many of the leading tramway companies, the Leeds and Bradford Corporation tramways departments have recently contracted for large supplies. The company recognises that a trial is the best test of merit, and is offering to supply a set of free samples of these special lamps to companies running electric cars. Full particulars can be obtained on application to the Sunbeam Lamp Co., Ltd., Gateshead-on-Tyne.

**Trade Announcement.**—Messrs. R. W. Vicarey & Co., storage battery experts, have moved into larger premises, and for the future their address will be 91, Foregate Street, Stafford.

**Hookham's Patent Prepayment Meters.**—We have received from Messrs. Venner & Co., 6, Old Queen Street, S.W. (sole agents for Messrs. Chamberlain and Hookham, Ltd., the patentees and manufacturers), particulars of the above prepayment meter. It consists of one of the firm's ordinary (alternating or direct current) motor meters, combined with a prepayment mechanism. The latter is designed to overcome the difficulty which has previously been experienced in dealing with damaged or worn coins; the coin in this case simply releases a corresponding check from a reservoir, and the check switches on the current during the prearranged period. The checks are in the form of flat disks or small spheres, accurately made to size.

In the accompanying figure (the meter being arranged for continuous currents), A is the check reservoir, drawn with part of the exterior removed so as to exhibit the checks. The checks are put into this groove from the top and escape one at a time at the bottom. B is the slit into which coins are inserted so as to fall into the receptacle C. D is a lever projecting through the front of the case. After a coin has been inserted and has fallen into C, the lever D is moved to the left; the coin standing edgewise in C first encounters and lifts the catch E, thus allowing of D being moved still further; it then falls over the edge of an inclined plane F, which prevents the possibility of D returning until the coin has been discharged into the coin drawer on the left. The forward movement of D works a small pusher under the check reservoir which carries out a check and drops it into the pivoted beam G. One check is sufficient to depress the beam, thus making contact by means of the mercury cups H and permitting a supply of current to pass to the lamps. Six or eight checks may however remain in the beam, allowing the customer to put in eight coins at a time. Each check as it falls into the beam passes over and tilts a small weighted lever at I, which is so arranged that if the beam becomes full of checks more cannot issue from the reservoir. This in turn prevents any more coins being inserted until, under the action of the meter, a



The Hookham Prepayment Meter.

check has passed from the beam. The release of the checks from the beam is effected through the medium of the counting train of the meter. One of the wheels carries the crank-pin J, which, in rotating, rocks the connecting rod and lever K K backwards and forwards. To the lever K is attached a horizontal bar carrying two small vertical screws L L; the whole arrangement forms a kind of escapement, the slow to and fro movement of which releases the checks one at a time. The speed of the meter and the wheel train of the counter are so adjusted that the desired value in electric current releases one check from the beam. After escaping from the beam each check falls into the check drawer on the right-hand side of the meter. The coin and check drawers are secured by vertical spring bolts at the back of the meter, which are depressed by the movement of a horizontal bar along the top of the case. The screw N, which can, if necessary, be got at from the outside, presses down the end of the beam firmly down upon the mercury cups, effectually sealing them up and preventing loss of mercury in transit. Different counting trains are provided according to the price per unit which is to be charged, and they are stamped accordingly. The wheel on the worm spindle may be varied according to the voltage of the supply and the constant of the meter, in the same way as in the firm's ordinary meters, and change wheels for this purpose can be supplied. The dial reads up to 999 B. of T. units. It will be seen that the prepayment mechanism is of a very simple description, and the more important details are, moreover, capable of adjustment.

**The South Lancashire Electric Traction Co.**—At a vacation sitting of the Lancashire Chancery Court on 16th inst., at Liverpool, before Mr. Registrar Taylor, sitting as Deputy Vice-Chancellor, a debenture-holder's application was made in the matter of Krauss and others *v.* The South Lancashire Electric Traction and Power Co. and others. Mr. Preston, for the applicants,

said that this was a debenture-holders' action for the appointment of a receiver and for inquiries and accounts. The company did not oppose, but the trustees had put in a defence. Mr. Stewart Deacon, for Sir William Forwood and Mr. W. S. Barrett, trustees for the debenture holders, said the only point his clients made was as to the remuneration to which they were entitled. The arrangement was for £100 a year each, and as these proceedings might be prolonged, they wished to have the question of their remuneration determined. The Deputy Vice-Chancellor made an order in the terms of the proposed minutes, with the addition of an inquiry as to the trustees' remuneration.—*Manchester Guardian.*

**Liquidations.**—A winding-up order having been made against Shippey Brothers, Ltd., 13 and 14, King Street, Cheapside, electrical engineers, &c., the statutory meetings of the creditors and shareholders were held on Friday, August 19th, at the Carey Street offices of the Board of Trade, Lincoln's Inn, W.C. Mr. H. Brougham, Official Receiver, reported that the winding-up order was made last month on a creditor's petition, but he had not yet had an opportunity of investigating the company's books. The company was registered in December, 1887, with a nominal capital of £30,000, divided into 6,000 shares of £5 each, to acquire the business of Shippey Bros., electrical engineers and American agents, together with the plant, machinery, stock-in-trade, and certain patent rights (British and foreign) of Mr. Arthur Shippey. That gentleman was appointed managing director on June 9th, 1888, at a salary of £300 for the first year, £400 for the second, and £500 for the third year, with an additional commission of 25 per cent. on the net profits after 10 per cent. had been paid to the shareholders. The qualification of a director, with the exception of the first directors, was the holding of £200 in shares or stock of the company. Under the articles of association the directors were not to be less than three or more than than seven, but since 1892 Mr. Shippey and Mr. Beckwith had been the only directors. The last meeting of the board of directors was held in February, 1892, since which date Mr. Shippey had apparently taken the entire control of the company's affairs. Mr. Arthur Shippey started trading as Shippey Bros. in 1869, and he estimated his yearly profit at an average of £400 or £450 down to the formation of the company, but there was nothing in the shape of accounts to substantiate that estimate. The purchase price paid by the company was £8,000, of which £100 was discharged in cash and the balance in fully-paid shares. Throughout the company's existence no balance sheet or profit and loss account had been prepared by the directors, so that it was impossible to state the result of its trading. The total number of shares issued was 2,412, representing £12,060. On March 12th, 1888, the interest of Mrs. A. Yowells in certain patents was purchased by the company for £3,000, paid in shares of the company, and on the same date the interest of Mrs. A. P. Lovering was acquired in certain patents for £2,000 also paid in shares. In 1901 an arrangement was made with the Motor Traction Co., of Kennington, for the latter company to finance this company in consideration of receiving a proportion of the profits. That arrangement lasted for about 18 months, and, added the chairman, would require to be carefully investigated. The unsecured debts of the company amounted to £3,238; there were fully-secured creditors for £315, and the free assets were valued at £1,838. In March last a creditor obtained judgement against the company for £145 and costs, and it was in respect of that judgement that the winding-up order was made. The company had apparently traded at a loss throughout. In reply to a creditor, Mr. Shippey said although they had been selling the Ford motor-cars as agents, the agency agreement had not yet been signed. The creditors passed a resolution for Mr. Percy Mason, chartered accountant, 64, Gresham Street, E.C., to act as liquidator, with the assistance of a committee of inspection. In the absence of a quorum the meeting of shareholders was formally adjourned for a week.

Creditors of Refuse Destructors, Ltd., are to send particulars of their debts, &c., to the liquidator, Mr. F. H. Firth, 249, Dashwood House, E.C., by September 15th.

Messrs. James Lochhead & J. P. Rhodes (The Huddersfield Electric Co., Cloth Hall Street, Huddersfield) have dissolved partnership. Mr. Rhodes will attend to debts.

A meeting of the Single Wire Multiple Telephone Signal Co. is to be held at Electra House, E.C., on September 26th, to hear an account of the winding up from the liquidator.

**Book Notices.**—"The Diseases of Electrical Machinery." By Ernst Schulz. London: E. and F. N. Spon. 2s. net.

"British Standard Tables of Copper Conductors and Thicknesses of Dielectric, and Specification for Tubular Tramway Poles." Nos. 7 and 8. Interim Reports issued by the Engineering Standards Committee. London: Crosby Lockwood & Sons, or the Committee. 5s. net.

"Antologia della Melica Greca." Del Dr. Angelo Taccone. Collezione di Classici Greci e Latini con note Italiane. Torino: Ermanno Loescher. L. 4,50.

"The Centrifugal Pump, Turbines, and Water Motors." By Charles H. Innes. London: The Technical Publishing Co. 4s. 6d. net.

University of London, Regulations relating to Degrees in Arts, for External Students. From the External Registrar, South Kensington. 1904.

**Sales.**—On September 13th Messrs. Brackett & Sons will sell certain private electric light plant by auction at North Finchley. Messrs. Wheatley Kirk, Price & Co. are offering a stock of electric light fittings for sale by tender. Messrs. P. Huddleston & Co. will, on September 1st, sell the stock of an electrical engineer by auction at Manchester. Some particulars are given among our advertisements to-day.

**Notes on Lamps.**—Impressed by the ignorance and carelessness of electric light consumers regarding the useful life of glow lamps, the principles of illumination, &c., Mr. G. H. Cottam, borough electrical engineer to the Hampstead M.B.C., has compiled a little booklet on the subject in non-technical language for their edification. A number of data are given, with quotations from various authorities bearing on the subject. A table from Molesworth at the end of the pamphlet shows how gas, oil, and candles pollute and heat the air, whilst electric light does neither.

**Catalogues and Lists.**—Messrs. Royce, Ltd., of Hulme, have issued a new dynamo and motor catalogue, in which are illustrated and described some of their most up-to-date machines. Tabulated information is given regarding the outputs and speeds of the different sizes of machines at various voltages.

Messrs. Drake & Gorham, Ltd., of Victoria Street, S.W., have sent us a copy of their latest priced catalogue of Nernst lamps of the German and English patterns, ceiling and projector types, also special reflectors, replacement pieces, &c.

A price list of Dermatine valves has been issued by the Dermatine Co., Ltd., of Camberwell. Some introductory comments, by an expert, on valves for air pumps and condensing plant are followed by some very clearly-drawn diagrams of the different valves and of the improved guards and grids.

The Electric and Ordnance Accessories Co., Ltd., have sent us one of their very taking coloured show cards, which have recently been issued in connection with the Stellite S.D. telephones. Any interested member of the trade can obtain a copy of the card by applying to the company.

We have received from the Simplex Steel Conduit Co., Ltd., an ingenious show-card, which will doubtless be very useful to the company's numerous patrons. It consists of a flexible varnished sheet of moderate size, illustrating a considerable number of the well-known Simplex fittings, the rollers for the sheet consisting of Simplex tubing.

Mr. Fred. J. Down, of Crutched Friars, E.C., is supplying an electric sign flasher for electric signs, flags, window displays, and general illumination. It consists of automatic rotary switches driven by a small electric motor.

From Messrs. Holden & Brooke, Ltd., of West Gorton, we have received List No. 8, illustrating and fully explaining their "positive flow" hot water system for heating buildings, &c.

From Messrs. Ferranti, Ltd., of Hollinwood, we have received a further number of illustrated catalogues; they deal respectively with C.C. reverse-current relays, moving-coil instruments, integrating and indicating wattmeters, and transformers for use with same, also A.C. maximum-current reverse relays.

A price list of radial battery regulators has been brought out by Messrs. Ernest F. Moy, Ltd.

The Berliner Telephone Manufacturing Co. is sending out some new leaflets relating to its "Parlyphone" and other telephone instruments.

Messrs. Rainsford & Lynes, Ltd., of Emily Street, Birmingham, are supplying a line of English made lampholders, and a small list of prices is in circulation.

**Condensing Plant.**—The Wheeler Condenser and Engineering Co., of Norfolk Street, W.C., well known for their condensing plant, have in hand at present among other work the following:—For the Liverpool Corporation at their Lister Drive station, two 2,000-H.P. surface-condensing plants, with five water-cooling towers; Borough of Southampton, surface-condenser with horizontal steam-driven pumps for 10,000 lbs. steam per hour; Belfast Corporation, a similar outfit for 25,000 lbs. steam per hour (fifth installation); Hastings Corporation, water-cooling tower, circulating pump and engine (third installation); Bromley Electric Light Co., water-cooling tower (repeat order); East Ham Tramway station, similar outfit for 18,000 lbs. steam per hour; for the L.C.C. new Technical Institute at Poplar, standard double-tube surface condenser with steam-driven Edwards air-pump (testing plant for steam consumption); for the Um Rus Gold Mines, two similar plants, each for 10,000 lbs. steam per hour, with oil separators; De Beers Mines, Kimberley, two water-cooling towers for 40,000 lbs. of steam per hour (repeat order); Sheepbridge Coal and Iron Co., vertical condenser with steam-driven air and circulating pumps for 15,000 lbs. steam per hour; for Richardsons, Westgarth, jet condenser with wet and dry vacuum pumps for their Tees-side works. The firm also have in hand a number of condensing outfits for turbine plants for export to Japan, also plants for Johannesburg, Bangkok, and numerous other export orders.

**Dix-Sandford Patent Starting Switch.**—With regard to this ingenious switch, which was described in our report of the discussion on Mr. Hunt's paper last week, we are requested to mention that it has been patented in Great Britain and abroad by Messrs. Sandford & Dix, engineers, 44, Waterloo Street, Birmingham, to whom all communications should be addressed.

**Annual Outings.**—Bamburgh, on the rugged coast of Northumbria, was the place selected by the men of the Sunbeam Lamp Co. for their outing on the 13th inst. The party was accompanied by the secretary, Mr. T. J. Grainger, and the assistant manager of the works, Mr. H. W. Edmundson. After some excellent sports, dinner was provided at the Victoria Hotel. After tea the prizes were presented to the successful competitors, and toasts were given wishing "Prosperity to the Company."

The annual outing of the mains and building departments of the City of London Electric Lighting Co., Ltd., was held at Windsor on Saturday last, under the presidency of Mr. F. B. Dew, the other

departments having already enjoyed their holiday earlier in the year. The day started with the cricket match between Mr. Dew's eleven and Mr. Moore's eleven, which was played on the ground of the Home Park C.C., and ended in a victory for the former by 30 runs, the scores being respectively 80 and 50. Dinner was later on served at the Liberal Club Hall. After the toasts some of the party visited the Castle and others Virginia Waters, but the majority availed themselves of boats and steam launches on the river. During the evening a smoking concert was held.

The works' picnic of Messrs. Ward & Goldstone, of Manchester, took place on Saturday, August 20th. A party of about 200 set out, and had a very enjoyable day at Lymm. After a cricket match, dinner was served at the Farm. The afternoon was devoted to sports. The expenses were entirely covered by the firm, without any outside help.

**Tramway Point Controllers.**—Messrs. S. Dixon and Son, Ltd., have received an order from the Birkenhead Corporation for the installation of their automatic point controller on its tramways system.

**Uralite.**—There is to be a fire test of Uralite in a yard at 178, Crown Street, Liverpool, on Monday next, August 29th, and any of our readers in the Liverpool district who wish to be present can do so by applying to the British Uralite Co., Ltd., at 50, Cannon Street, E.C., or at 10, South Castle Street, Liverpool.

**Bankruptcy Proceedings.**—There was down for disposal at the County Buildings, Glasgow, on Tuesday, the examination in bankruptcy of J. Pearce & Co., electrical engineers, 212, Bath Street, Glasgow; and Henry John Robertson, residing at 52, Darnley Road, Pollockshields, Glasgow, but who is believed to be at present furth of Scotland; and John Martin Carr, residing formerly at 3, The Oriels, Shawlands, Glasgow, now at 1, Redcliff Terrace, Strathbungo, Glasgow, but who is also believed to be at present furth of Scotland, the only known partners of said firm, as such partners, and the said Henry John Robertson as an individual. Neither of the parties appeared, and the examination was adjourned *sine die*.

A receiving order has been made on a creditor's petition against J. W. Hunter & A. Clapham (the Yorkshire Motor Car and Electrical Engineering Co., Leeds). The first meeting and public examination are arranged for August 29th and September 13th.

## LIGHTING AND POWER NOTES.

**Batley.**—The Corporation's abstract of accounts just published, shows that the capital expenditure on the electricity works, on which interest has to be paid, is £27,933. The loss for the eight months, ended March 31st last, is shown to be £864. There has been received by sale of energy under contract (to the Traction Co.), £898, and the sale to private consumers has yielded £361, about two-thirds of this being for lighting, and one-third for motive power. The tramways undertaking, it appears, has cost £42,870. The lines have been leased to the British Electric Traction Co., and from August 6th last year to March 31st last, £1,644 was received in rent, from the company. The deficiency is set down as £168 12s. 6d.

**Bradford.**—An interesting case of, shall we say, absent-mindedness, is brought to light by a letter to the *Yorkshire Daily Observer*, a correspondent complaining that certain public roads in his district of the borough are still lighted by means of oil lamps, which, to make matters worse, are turned out at 9 p.m.

**Cannock.**—At the resumed inquiry into the application of the U.D.C. for power to borrow £13,000 with a view to supplying electricity for lighting and power purposes within the Council's district, it was contended that the opposition was practically one, as the directors of the colliery company were also directors of the Cannock Gas Co. It was also stated that a canvass of the district showed there was a demand by 173 consumers. Mr. Henry Lea, of Lea & Son, consulting engineers, Birmingham, gave evidence on behalf of the opposition, and subsequently the inspector visited the district.

**Cardiff.**—From the report on the E.L. supply department for the year ended March 31st last, we gather that the total income for the year was £29,368, and the working expenditure £17,838, leaving a gross profit of £11,530. Interest and sinking fund charges, with a small amount for consumers' deposits, amounted to £9,151; the net profit on the year's working being thus £2,379. The number of units sold totalled 2,385,472; the number of public lamps supplied was 519, all but 100 of these being arc lamps. The H.P. of motors connected was 583.

**Church Stretton.**—The U.D.C. has decided to accept the gas company's tender for lighting the town for three seasons, at £90 per season. In discussing the matter, an amendment was proposed that the tender of the Electric Supply Co. should be accepted (the cost being £91 a season). The Electric Supply Co. were prepared to put in lamps at no extra cost to the ratepayers. The gas company, on the other hand, required 12s. 6d. for each additional lamp, and as the Council had agreed to have 9 new lamps there was a loss to the ratepayers of £5 12s. 6d. on the one item. The gas lighting of the previous season had been a failure.

**Continental Notes.**—*Waterfalls in France.*—From statistics just published by the Office of Works in France, it appears that there are in France some 4,600 stations on unnavigable streams and rivers utilising 4,900 waterfalls, representing 500,000 H.P. Seven departments have over 1,000 stations each. In Isère alone there are 1,049 stations, with an output of 36,700 H.P., eight of these giving 16,000 H.P., and one giving 5,000 H.P. The largest station is in Savoie, and has an output of 11,000 H.P. In addition, there are 1,500 stations, with an output of 86,000 H.P., situated on navigable rivers. The largest of these is in the Rhone province, with 5,000 H.P.

*Belgrade* (*Servia*).—The concession for lighting and tramways which was abandoned some years ago has just been taken up by a Belgian combine. The power station will contain seven sets giving 2,000 KW.

*St. Etienne.*—The town has now obtained powers, after a long dispute with the local company and the general council of the department, to utilise the River Lignon, and to create a power station for lighting and power in the district.

*St. Alban* (*Lozère*).—A new hydro-electric station is soon to be put into service, only the overhead lines remaining to be placed. The generators are by Boucherot, and the fall is 18 metres. The total output of the station is 5,000 KW., and the flow of water is 300 litres per second. The installation has been carried out by Breguet & Co.

*Martingalindez* (*Spain*).—A new generating station has been placed in service here, situated at 78 kilometres distance from Bilbao. The pressure at the generator terminals is 3,000, raised to a line pressure of 30,000 volts. The total output of the station is 3,000 KW., and it is intended to work in parallel with another station with an output of 4,500 KW. under construction at Puentelarra. At Bilbao the three-phase pressure is lowered to 3,000, and the transformer station provides for an ultimate transmission of 12,000 KW A third station of 3,000 KW. is to be provided later at San Sebastian All this power is used in Bilbao and district.

**Derry.**—The new station for the private lighting and power supply will be completed by the middle of next month. It is expected that a limited supply will be available this week if required.

**Dublin.**—On 17th inst., after considerable discussion, the report of the Lighting Committee in reference to the extension of the plant at Pigeon House station (involving the borrowing of £21,000) was formally agreed to by the Municipal Council.

**Dundee.**—The details of a scheme promoted by Mr. George Balfour, London, for the establishment of an electrical power supply company in Dundee, were discussed at a recent meeting of the T.C. The draft agreement proposed that the company should have the use of the streets, so far as necessary for its purposes. It bound itself not to supply any of the customers at present connected with the Corporation supply, and if the Corporation desired any further special exemptions the company would consider these.

**Dunfermline.**—In reporting on the proposal to introduce the electric light into this town, Mr. J. A. Bell (Aberdeen) unhesitatingly advised the Council to come to terms with the Fife Electric Power Co. for a bulk supply, in preference to generating its own energy.

**Glasgow.**—At the fortnightly meeting of the T.C., Councillor Willock, the convener, moved the approval of the accounts of the Electricity Department, a summary of which has already appeared in the ELECTRICAL REVIEW. Bailie Burrell, in seconding, said he thought the Council would admit, that that department of the Corporation had arrived at a very satisfactory position. Mr. W. F. Russell did not regard the accounts as satisfactory. He did not think the Committee was providing anything like adequate depreciation, and, in his view, it should not be less than 7½ per cent. Mr. Alex. Murray supported this speaker's views.

**Gosport.**—There appears a likelihood of the electric light being introduced into this district in the near future. The prov. order expires in December next; the Provincial Tramways Co. have powers to undertake this work, and the Empire Electric Light and Power Co. and Mr. G. Vaughan Fowler have also stated their intention of applying for powers to carry out the work.

**Hammersmith.**—The following statement shows the result of the working of the B.C. electric lighting undertaking for the year ended March 31st last, together with the figures for the preceding year:—

| | 1904. | 1903. |
|---|---|---|
| Revenue, private lighting | £27,149 | £21,604 |
| ,, public lighting | 4,081 | 3,987 |
| ,, meter rents and sundries | 1,495 | 1,595 |
| Total | £32,725 | £27,186 |
| Total working costs, including public lighting | £19,276 | £16,255 |
| Interest, &c. | £5,991 | £5,353 |
| Sinking fund | £5,603 | £4,514 |
| Profit balance for the year | £1,855 | £1,064 |
| Inclusive average price obtained per unit | 3·53d. | 3·66d. |
| Total works cost per unit | 1·405d. | 2·24d. |
| Total number of units sold | 2,223,923 | 1,736,839 |
| Maximum load recorded | 1,596 | 1,320 |
| Total capital expended | £204,935 | £190,329 |
| No. of 8-C.P. lamps connected | 85,693 | 66,224 |

The sum placed to reserve now amounts to £2,500, and the balance carried forward to next year's account £3,169. In the revenue item sundries, for 1903, is included sums of £325 refunded in respect of over-payment of tax and £379 allowance for rates overpaid during year ended March, 1902.

**High Wycombe.**—The T.C. has decided to enter into a contract with the Wycombe Borough Electric Light and Power Co., Ltd., for street lighting, provided that the number of arcs be increased from 11 to 12, that 279 small lamps be fitted to carry

½-ampere Nernst burners giving 70 c.p., that the company provides a photometer for testing the lamps, and that the cost be as follows:—12 arcs at £13 each per year; Nernst lamps, £3 each.

**Kent Electric Power Co.**—From a Parliamentary Return recently issued, it appears that the Kent Electric Power Co. has now ascertained by arbitration the price to be paid for acquiring under its Act of 1902, the undertaking of the Chatham, Rochester and District Electric Lighting Co. as a going concern. The company has also entered into an agreement with the Chatham and District Light Railways Co. (which is to take the whole of its energy from the power company, not only for its existing system of tramways, but also for the Rochester Corporation Tramways and its present and future extensions), for the purchase of the whole of the plant in the existing power house at Chatham. It has been found necessary to abandon the scheduled site for a power station at Chatham; and in order to get the coal conveyed direct from the steamers, the company has acquired a site of eight acres for the erection of a central station at Frindsbury, with berthing facilities for steamers of large tonnage alongside. The preliminary installation at this station will consist of about 6,000 h.p. Negotiations are also pending for the erection of another power station at Northfleet. Many contracts have been entered into for the supply of a very large amount of electrical energy to manufacturers and others in the locality. The company was instrumental, through the Kent Electric Power Syndicate, Ltd., in promoting last Session several prov. orders in the county of Kent, and steps are to be taken to put these orders into operation at an early date.

**Kingstown.**—The Council has arranged a settlement of Messrs. Kincaid, Waller, Manville & Dawson's claim for consulting work in connection with the Council's lighting scheme, for the sum of £500. The account had been in dispute for a period of six years.

**Linlithgow.**—At a meeting of the C.C. it was decided to apply for a prov. order for electric lighting, and to borrow £3,500 for the scheme. The proposal is to light Broxburn and Uphall, and the estimated cost of the contract is £2,500.

**Louth.**—The T.C. has authorised Messrs. Handcock and Dykes to prepare the plans connected with the electrical installation.

**Mansfield.**—At a meeting of the T.C. on the 19th inst., the Electrical Committee reported that it had arranged for the borough electrical engineer to have sole control of the cremation of refuse, and to pay the men employed. The borough surveyor to deliver and remove the clinker from the clinker yard. The electrical engineer to attend the Health Committee meetings as required. A sum to be paid to the Electrical Committee in respect of these services, of £60 a year. The Electrical Committee to pay to the Health Committee 6d. for each ton carted by the former, and a similar sum for each ton of coal saved by the refuse cremated in the destructor. The Electrical Committee to pay to the Health Committee 1½d. for each load weighed.

The Committee also submitted a report relating to the first nine months' working of the undertaking, from which it appeared that a gross profit of £825 had been made, but interest amounted to £1,784, thus leaving a deficit of £953 3s. 5½d. The number of consumers connected at the end of the first quarter was 60, with an equivalent of 5,512 8-c.p. lamps, and on March 31st, 1904, 102, with an equivalent of 7,854 8-c.p. lamps. The total number of units sold was 144,978, and the average price realised per unit was 3·23d. The maximum load was 127 kw. A filtering apparatus has been put in to enable the water from the river to be used for the boiler-feed, and a new weir has been constructed at the foot of the dam. The undertaking completed its first 12 months' working on June 30th. The accounts show very satisfactory results, which reflect great credit on both Mr. E. Holcombe Hewlett, the borough electrical engineer, and the consulting engineers, Messrs. Robert Hammond & Son. The works costs were 1d. per unit, and the total costs were 1·70d. per unit on an output of 177,658 units. The works were designed for supplying energy to the tramway company as well as for private lighting and power, but the construction of the tramways has not yet been completed.

**Newcastle-on-Tyne.**—The question of extending the electric lighting in Newcastle streets has been under consideration by the Lighting Committee. It was decided to ask the Tramways Committee at what price it would be prepared to supply the current.

**Pitlochry.**—A public requisition has been promoted asking the consent of the trustees of Mr. G. F. Barbour, of Bonskeid, to the utilisation of the water of the River Tunnel in connection with the proposed introduction of electric light into Pitlochry. The adoption of the scheme, it has been pointed out, would enhance the attractions of Pitlochry as a summer resort.

**Plymouth.**—At the L.G.B. inquiry held on August 18th, relative to the application of the T.C. for a loan of £20,000 for electricity purposes, and £4,460 in respect of the refuse destructor, it was proposed to add a 500-kw. steam alternator, Lancashire boilers, and automatic stokers to the electricity plant. There was no opposition.

**Radcliffe.**—The electricity supply of the town for lighting purposes was brought into use on Friday last, the Market Hall and other public buildings being illuminated.

**Rathmines.**—The accounts of the U.D.C.'s electricity undertaking for the year ending March 31st last, show that a gross revenue of £7,467 was earned, and a total working expenditure of £3,998 incurred, leaving a gross profit of £3,469. Financial and other charges absorb £4,758, a deficit of £1,289 being made. The total output was 511,761 units, the maximum demand 299 kw., and the number of public lamps 108 arcs, and 350 incandescent.

**Ravensthorpe.**—Mr. Woodhouse, engineer to the Yorkshire Electric Power Co., has had an interview with the District Council to explain the terms on which the company would be prepared to supply electricity to the Council in the event of the latter obtaining a provisional order. He suggested an agreement similar to the one concluded with the Mirfield Council. The latter Council felt it could not expend the necessary £8,000 or £9,000 in order to supply power and light to everybody in the district. It had, therefore, agreed only to take electricity for light and for small users, leaving the company to supply the large consumers. The Council promised to consider the matter and communicate with Mr. Woodhouse.

**Rawtenstall.**—At a recent meeting of the Trades and Labour Council a resolution was unanimously passed strongly disapproving of the action of the T.C. in engaging to take a supply of electricity from a company, and repeating the short-sighted policy which has put all the remunerative services, such as trams, gas, and water, into the hands of companies.

**St. Annes-on-Sea.**—The financial result of the last year's working of the Council's electricity undertaking, ended March 31st, 1904, was as follows:—

| | 1904. | | 1903. |
|---|---|---|---|
| Revenue, private and public lighting .. | £3,644 | | £2,866 |
| ,, traction purposes, including meter rents and sundries .. | 2,861 | no traction | 69 |
| Total .. | £6,505 | | £2,935 |
| Total working costs, including public lighting .. .. .. .. .. .. | £3,204 | | £1,416 |
| Interest .. .. .. .. .. .. | £891 | | £791 |
| Sinking fund .. .. .. .. .. | £855 | | £699 |
| Balance transferred to depreciation fund .. | £1,555 | | £30 |
| Total works cost per unit .. .. .. | 1·58d. | | 2·18d. |
| Inclusive average price obtained per unit .. | 3·22d. | | 4·52d. |

The number of units sold is:—For traction, 293,481; public and private lighting, 190,511; total, 483,992; lamps connected in equivalent 8 c.p., 14,033; number of consumers, 249; maximum load, 401 kw.

**Sheffield.**—The following are the revised rates for power supply which are to take effect from December 26th next:—

| | |
|---|---|
| 1. For all power used in motors driving hoists, cranes, passenger lifts, and similar machinery .. .. .. | 2d. per unit. |
| 2. For other motors .. .. .. .. .. .. | 1½d. ,, |
| 3. To consumers satisfying the general manager as to the continuous running of their motors throughout the whole of the working hours of each day, whose consumption does not exceed 5,000 units per annum .. | 1½d. ,, |
| 4. To consumers complying with clause 3, whose consumption exceeds 5,000 units per annum .. .. .. | 1d. ,, |
| 5. From the above rate of 1d. per unit, discounts will be allowed as follows:— | |
| 10,000 units per annum .. .. .. .. .. .. | 5 per cent. |
| 15,000 ,, ,, .. .. .. .. .. .. | 10 ,, |
| 25,000 ,, ,, .. .. .. .. .. .. | 15 ,, |
| 50,000 ,, ,, .. .. .. .. .. .. | 20 ,, |
| 100,000 ,, ,, .. .. .. .. .. .. | 25 ,, |
| 250,000 ,, ,, .. .. .. .. .. .. | 30 ,, |
| 500,000 ,, ,, .. .. .. .. .. .. | 35 ,, |
| 750,000 ,, ,, .. .. .. .. .. .. | 40 ,, |

All accounts will be rendered at the fixed price per unit, and the discounts will be credited according to the consumption at the end of every half-year, in September and in March.

This should be read in conjunction with our note on the same subject in last week's issue.

**Swadlincote.**—The U.D.C. has resolved to oppose the application of Mr. G. Vaughan Fowler, of Warwick, for a prov. order for electric lighting.

**Tewkesbury.**—The Tewkesbury Gas Co. has given notice of its intention to apply for a prov. order to supply electrical energy throughout the borough.

**Walthamstow.**—The result of the year's working of the municipal electric light undertaking, ended March 31st, 1904, we give below, with comparative figures of the previous year's operations:—

| | 1904. | | 1903. |
|---|---|---|---|
| Revenue, private lighting .. .. | £9,191 | | £6,476 |
| ,, public lighting .. .. | 2,932 | | 2,548 |
| ,, meter rents and sundries.. | 1,049 | | 1,104 |
| Total .. .. | £13,172 | | £10,128 |
| Total working costs, including public lighting .. .. .. .. .. | £4,663 | | £3,654 |
| Interest .. .. .. .. .. | £3,003 | | £1,563 |
| Sinking fund .. .. .. .. | £2,505 | | £1,905 |
| Applied to relief of rates .. .. | £3,001 | Carried forward | £3,006 |
| Total works costs per unit .. .. | 1·37d. | | 1·616d. |
| Inclusive average price obtained per unit .. .. .. .. .. | 3·88d. | | 4·48d. |
| Total number of units sold .. .. | 814,187 | | 542,423 |
| Maximum load recorded .. .. | 600 kw. | | 406 kw. |
| Total capital expended .. .. | £112,475 | | £75,521 |

The increased cost of fuel accounted for ·04d. per unit increase in cost of generation. Three additional gas producers were in operation, making five in all, and reductions both in the price for private and public lighting were made during the year.

**Wolverhampton.**—An interesting little ceremony took place on Friday evening in last week, when the chairman of the Electric Lighting Committee turned on the electric light in Tettenhall Road. Hitherto this main thoroughfare has been lighted with 35 gas lamps. In future it will be illuminated by 33 Nernst lights, each of 75 c.p.

# MESSRS. SIEMENS BROTHERS & CO.'S NEW MANUFACTORY AT STAFFORD.

(*Concluded from page* 304.)

Between the fourth and fifth bays, *i.e.*, at the approximate centre of the building, is situated the Sturtevant fan, by means of which fresh air is drawn in from the external atmosphere through a large duct, and distributed throughout portable tools are employed. The latter comprise portable drills and slotting machines, driven by electromotors, which receive their supply of motive power through flexible connections, with plugs and sockets. The bay is traversed by a

Exterior of Works from South-East. Cooling Pond in Foreground.

tl machine shops and the erecting and testing shops. In w ter the air is heated by being driven over pipes heated by thexhaust steam from the engines, and part of the air is fre drawn from the exterior, whilst part is re-circulated. Th fan is driven by a direct current motor.

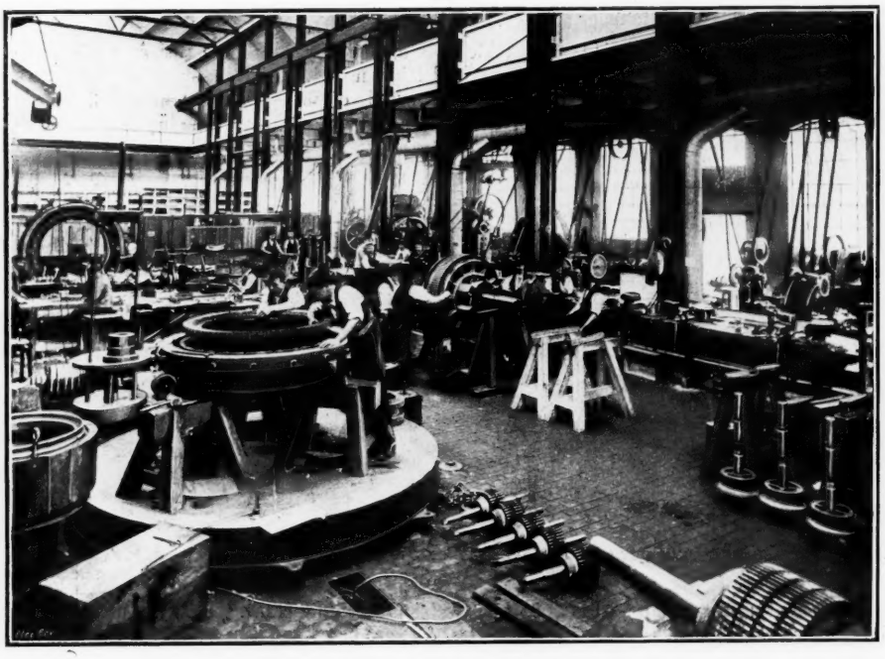
25-ton electric travelling crane. Heavy generator frames, bed-plates, &c., are bored and turned in this bay, and large commutators are machined.

The next bay is used for the winding of armatures of medium size, and the building of commutators; above,

Machine Shops: Bay No. 5.

The fifth bay is devoted to the heaviest descriptions of work; in this are to be found a boring mill capable of taking in work 30 ft. in diameter, 6-ft. and 12-ft. boring mills, large radial and other drills, and a bed on which there is a gallery in which armature coils are wound on formers, and armatures under 9 inches in diameter are wound. The larger armatures are built up and wound in the seventh bay, of which we give two views, looking from

the middle towards either end. In this bay were numerous armatures in course of construction for direct current generators and motors, stators and rotors for induction motors, stationary armatures for alternators (of which an especially large example is visible in the background of the adjoining



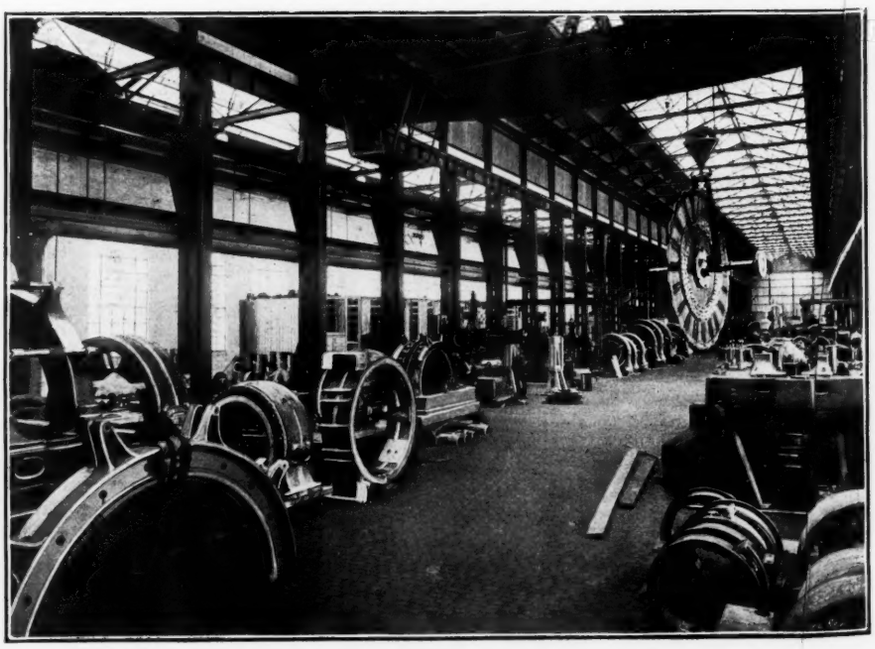
Armature Shop (Bay No. 7), Looking Eastwards.

view), and large commutators. Most of the dynamo armature winding is done in the western half of the bay, and here there is a vacuum tank for rapidly drying the armatures. A specially interesting machine seen in this department was a dynamo built for coupling direct to a Parsons steam turbine, in which a special winding is employed in conjunction with a slotted core. We are informed that exceptionally successful results have been obtained by this means in the elimination of sparking at the brushes with varying loads, a trouble which has hitherto manifested itself to an unpleasant degree in machines of this class.

The eighth bay is devoted to presses for stamping core plates for armatures and transformers, for which all the punches and dies are made in the tool room. Here, also, there is a plant for drawing down copper wire and strip for armature winding, &c., and for commutators. Just outside the building at the middle of this bay is an annealing furnace heated by water gas, for the treatment of core plates, &c., and copper wire.

A covered way between the machine shops and the erecting shop provides for the transport of wound armatures and field magnets from one department to the other without exposure to the weather. The erecting shop is shown in one of our illustrations on this page, the testing shop and packing shop being in the background. A variety of machines were in course of erection in this department, the most noteworthy being large iron-cored and air-cored alternators of imposing dimensions. The armature of one of the latter was approaching completion, and may be seen in the illustration, suspended from the travelling crane. This machine is destined for Ealing. The building is divided into three bays, of which the north bay is mainly utilised for the storage of small parts required in the adjoining erecting shop, the middle bay is used for assembling large machines, and the south bay for those of smaller dimensions. A standard-gauge siding runs across each end of the building, that at the east end being sunk below the floor level to facilitate the dispatch of machines when packed.

The testing shop we have already briefly described in connection with the power generating plant. It is equipped with all the necessary apparatus for testing machines of every description. We give a view on the next page showing a number of machines on the test-bed, including a direct-current generator for the Reading Corporation.



Erecting Shop.

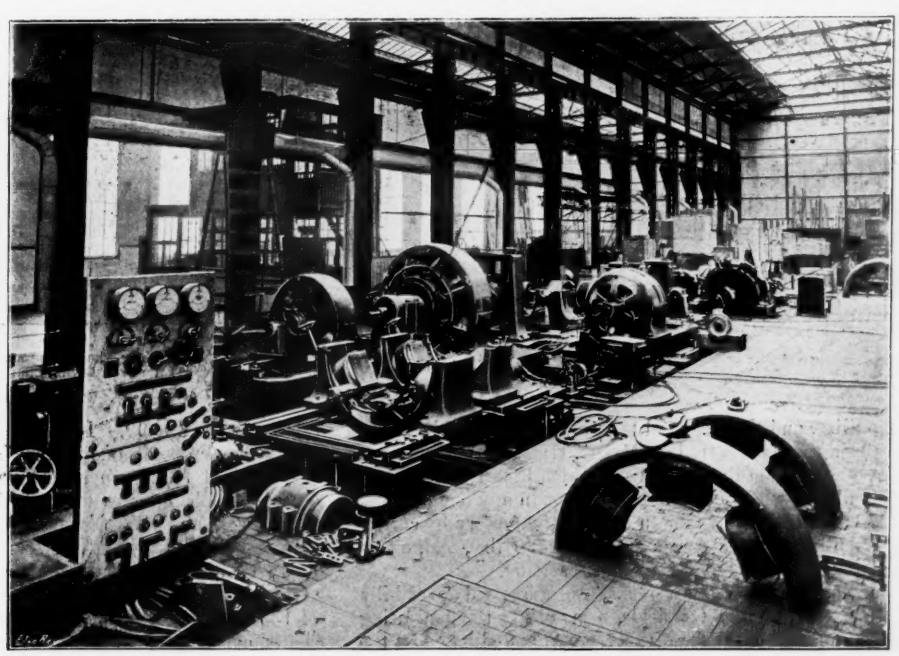
The packing department occupies the east end of the building, and a large roofed packing-case store has been erected outside the main building. A self-propelling steam travelling crane plies about the yards, and is found a very useful machine for shunting wagons and handling goods.

The gas plant, which was supplied by Messrs. R. & J. Dempster, is operated on the Dellwick-Fleischer system; it is situated between the offices and the machine shops, and includes a small gas-holder.

Armature Shop: Winding 3-phase Motors.

Mention should be made of the telephone service provided throughout the works, on the intercommunication system, and of the highly efficient fire brigade organisation, the members of which belong to the works staff. The brigade is kept up to the mark by frequent fire drills, and occasional false alarms to test its readiness for instant action, and so well are the duties performed that the brigade has already carried off several prizes in competition with other similar organisations.

From the foregoing description, brief though it be, it will be seen that in their new engineering works Messrs. Siemens Brothers possess the means of turning out electrical machinery of any size and description that they may be called upon to construct, while the arrangement and lay-out of the plant are such as to ensure the maximum of efficiency and economy, combined with rapidity in the execution of orders. Having regard to their high standing in the electrical world, we have no doubt that there will be no lack of opportunity for their staff to demonstrate their capabilities, and under the improved conditions now obtaining, they will have no difficulty in maintaining the reputation which they have so long upheld for thorough workmanship and sound material. We may conclude by expressing our good wishes for their prosperity, and our appreciation of the courtesy of all the members of their staff with whom we have had the pleasure to deal in the preparation of this article.



Testing Shop.

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**Electricity in Mills and Coal Mines.**—In the United States, according to Mr. Sidney B. Pain, who addressed a meeting of the National Association of Mill Managers at Manchester the other day, the electric drive in textile mills has passed the point where its utility and advantages can be questioned. Amongst its advantages are reckoned greater reliability and facility for enlargement or rearrangement. The cost of power is generally the first objection raised to the purchase of electricity. It is assumed that the central station cannot compete with the mill in that respect. That, however, does not necessarily follow; in fact, Mr. Paine contends that the reverse should be true. Wherever the electric drive, he says, has been used by manufacturers who had previously used the mechanical system, they have, without exception, remarked upon the steady and uniform speed which has resulted. That steady speed must tend to greater production, improved quality, and less repairs to machinery. In the present age of competition, the provision of a central power station frees the manufacturer from the consideration of all questions connected with the generation of power, and, to that extent, enables him to devote his energies more efficiently to his business. If he purchased his power from a central station, fluctuations in the price of coal, and kindred questions, caused him no anxiety.

## A NATAL THREE-PHASE TRANSMISSION PLANT.

An interesting example of the increasing application of electricity in South Africa is afforded by an installation of three-phase transmission by water-power, which is in successful operation on the tea estate of Messrs. J. L. Hulett & Sons, Ltd., at Kearsney, Natal.

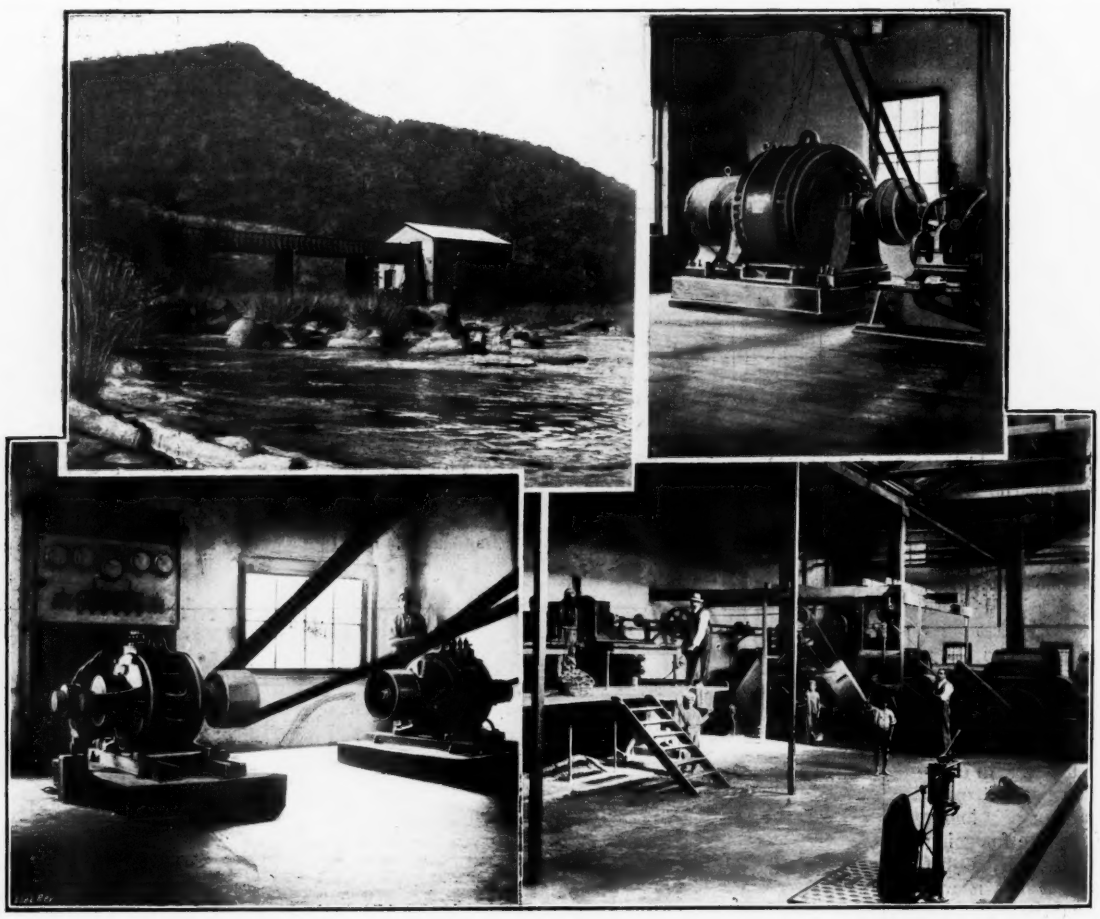
The Kearsney estate is about eight miles from the Stanger station of the Natal North Coast Railway, there being a light railway of 2 ft. gauge connecting it therewith.

The planting of tea started in 1878, and at the present time there are some 2,000 acres under cultivation, out of a total of 7,470 acres, all of which is good tea-growing soil; the soil is of more importance than the climate, and thus the area is restricted, as stiff sandy soil is found most suitable.

The annual output of tea in this Colony is about 1½ million lbs., and the imported tea works out about the same, there being no export trade. Messrs. Hulett & Sons produce about one million lbs. per season, which lasts from September to June, while the greatest output in any one day was 10,370 lbs. The leaf is brought into the factory by coolies twice daily, in sacks containing about 30 lbs., and, on an average, 24 hours later it is ready for sorting.

Turning to the electrical plant, a pleasant ride over hilly country, through the tea fields, brings us to the generating station, some 3¼ miles from the factory, and situated on the Umvoti River, from which the power is derived. Messrs. Hulett & Sons are to be congratulated on being the first in Natal to put to use Nature's own power for three-phase electrical transmission, and were it not for the fact of the "dry seasons" in South Africa, there is no doubt that many of the rivers could well be harnessed. The river at this point is about 100 ft. above the sea level, whilst the factory is 900 ft. higher. The overhead line to the factory is carried in a traight line over the hills, rising at one point 1,000 ft. above the generating station, which is shown in one of our illustrations. The construction of the dam, race and flume, as well as the building of the station, was carried out by Messrs. Hulett & Sons, under the supervision of Mr. A. Head, now district engineer to the P.W.D., at Durban. The dam wall is built of concrete, the proportions being 8 to 1, and is 170 ft. wide by 10 ft. high, tapering in thickness from 3 ft. 6 in. to 2 ft.

The height of water in the dam is 4 ft. above the original bed of the river; the intake gate is 12 ft. wide and the sluice gate is 3 ft. sq. The race took six months to cut through, as one-third of it was through boulders, necessitating blasting operations; its length is ¾ mile, with an average width of 20 ft., the water depth being 2½ ft., and the difference in level between the dam and the open flume, which is 244 ft. long, being 2 ft. The electrical plant was installed by Mr. C. W. Sully, of Durban (Messrs. Siemens's agent), at a cost of £4,500, and the total cost of the whole scheme was £8,000. In the generating station there is installed at present one turbine set, and ample room has been allowed for two more sets, which will probably be put down later, there being an available 300 H.P. in the river in the "dry season." With the possibility in view of extending the present light railway and electrically equipping it, there are hopes of using the power to its fullest advantage. The turbine was manufactured by the Smith-Vaile Co., U.S.A., is of 136 H.P., and has two 18-in. wheels fixed to horizontal shafts, enclosed in a wrought-iron case 6 ft. in diameter, of ample capacity so as to prevent any direct flow of water from the tank to the wheels, and to allow of all sand being deposited at the bottom of the casing. A belt-driven Ball governor controls the flow of water to the wheels by means of two metal sleeves, which cover the entrance to the cylindrical guide blades. These cylinders are worked by racks, manipulated by gearing outside the turbine casing on which the governor is fixed. The gearing has two pawls which are kept constantly in motion by the belt which drives the



Power Station, showing Flume. Three-phase Motors. Three-Phase Generator. Interior of Drying Chamber.

THREE-PHASE PLANT IN A NATAL TEA FACTORY.

governor, the function of the governor being simply to decide which of the pawls shall engage in the mechanism when there is any variation in the turbine speed, and its operation has proved very satisfactory. The turbine is situated 15 ft. below the water level of the intake, and is connected to it by means of a vertical pipe 4 ft. 8 in. in diameter.

The level of the water in the tail race is 15 ft. below the level of the turbine, making a total working head of 30 ft., the discharge pipes, of which there are two, being 2 ft. 7 in. in diameter.

The three-phase 100-KW. generator is by Messrs. Siemens and Halske, giving 11·6 amps. at 5,000 volts, at 500 r.p.m. and 50 cycles per second; it is star connected, and of the usual rotating field type, connected to the turbine shaft by means of a flexible coupling. The exciter is of the multipolar type, shunt-wound, giving 50 amps. at 120 volts, and is coupled direct. The switchboard is of very simple design, all live parts being at the back, with a small transformer for reducing the current to the instruments. There are two regulating resistances, one being in the exciter shunt and the other in the generator field, the reason for this being that the exciter is also used for local lighting. The overhead lines are carried on solid-drawn weldless steel poles, 30 ft. in height, spaced on an average 40 yards apart, and are supported by triple petticoat porcelain insulators, two being fixed to a cross-arm and one to the top of the pole. At all cross roads an efficient wire guard is fixed below the mains. The three wires are of No. 6 gauge, and carry the current at 5,000 volts to the transformers at the factory. A telephone line is also carried on these poles about 3 ft. below the mains, the wires being "staggered" from pole to pole to avoid induction effects. Lightning arresters of the Siemens' "Wurtz" type are fixed at each end as well as at other points along the route, and at the generating end the neutral wire is also protected by an arrester. So far very little trouble has been experienced from lightning, and in view of the severity of South African storms, this speaks well for the selection of the plant. Its simplicity is such that it only requires a coolie to look after it. The single-phase Siemens and Halske transformers are three in number, 30 KW. each, reducing the pressure from 2,845 to 70 volts, and are "star" connected, thus giving a difference of 120 volts between any two wires for driving the motors and lighting, the neutral wire not being utilised. The machinery is belt-driven off different lines of shafting by motors of various H.P., the shafting generally being so arranged that different lengths may be coupled together should any of the motors break down.

The factory is built of brick, 240 ft. long by 75 ft. wide, and is four stories high. All the upper floors are used for the "withering" where hessian is stretched on racks to receive the leaf, the area offered in all being about 600,000 sq. ft.; 1 lb. of leaf calls for 9 sq. ft. of withering space, and on an average 12 hours is required for this process.

Three Blackman fans, 4 ft. in diameter, assist the "withering" by drawing the hot air over the leaf from the drying chamber; these are driven by a 25-H.P. motor, which also drives two of the rollers of Jackson's Rapid type, made by Marshall & Sons, Gainsborough. Other five similar rollers and one Davidson's (open top) are driven also by a 25-H.P. motor. The two motors are shown in our illustration of the main motor room. The rolling process takes about 45 minutes, after which the leaf is sorted in its green state by two Davidson's mash sorters, driven by the 25 H.P. motor; the leaf is then taken to a room 45 ft. sq. for the oxidisation process, which takes anything from three to six hours in a temperature of 70°. From here the leaf is taken to the drying chamber, a room 90 ft. by 75 ft., containing two Jackson's 72-in. Venetians and one Paragon, also four Davidson's downdraft Siroccos and one Gibbs and Barry drier. These driers turn the leaf over several times, and the process is assisted by small fans drawing hot air from the furnaces in connection therewith. The mechanism of these driers is driven by a 25-H.P. motor, which also works two saw-benches. After the drying process the tea is sorted by two Davidson's sorters; the coarser qualities are then passed through Jackson's breakers, driven by a 5-H.P. motor.

In addition to the main building there is a carpenter's shop with a 5-H.P. motor driving two planing machines, a lathe, circular and band saws, and a workshop and smithy with a 2½-H.P. motor driving drill, lathe, hack saw, shaping machine, &c.

All the motors are of the usual induction type, supplied by Messrs. Siemens & Halske, but they have no slip rings attached to the rotor, in place of which they are fitted with a centrifugal switch mounted on the shaft and controlling two windings in the rotor. To start the motor it is thus only necessary to close the main switch; the motor then starts with its two rotor windings in series, and as the motor attains a certain speed the centrifugal switch comes into action, and puts the two rotor windings in parallel.

The factory is lighted throughout by 55 16-C.P. lamps, and Sir J. T. Hulett's residence by 152 16-C.P. incandescent and three arc lamps, the wiring being evenly balanced on the three phases. The lighting mains to the house are carried overhead for a distance of 200 yards from the factory, the road being lighted by lamps carried on brackets fixed to the poles. We are pleased to acknowledge our indebtedness to Messrs. J. T. Hulett & Sons, and to their factory manager, Mr. G. A. Hopkins, as well as to Mr. C. W. Sully, the electrical contractor (who accompanied our representative to Kearsney) for the information so readily given, and for the facilities in obtaining photographs of the plant.

## TRAMWAY AND RAILWAY NOTES.

**Brooklyn.**—Commencing in December next, considerable improvements are to be made in the electrical equipment of the Rapid Transit Co.'s line. Many of the old and evil-smelling cars are now being rebuilt, the chief point in the reconstruction being the provision of a fireproof flooring and better seating arrangements. A correspondent writes:—

The system of control adopted is the Westinghouse unit switch group control, recently described in your pages. Each motor car is equipped with two 150-H.P. motors. Trains are usually made up of five cars, consisting of three motors and two trailers, giving 900 H.P. per train. This power gives a maximum train speed of 42 miles per hour. The trucks have been designed especially with a view to afford smooth running, and the brake mechanism has been arranged to give easy stops. Emergency valves have been placed in each car, so that the train can be stopped from the platform or any part of the interior of any car. A new type of gate has been applied, making it easier for passengers to enter or leave the train. All cars are now being coupled together with automatic couplings. All cars are equipped with fire extinguishers of the most modern type, and these are regularly inspected.

**Bury.**—In April last the Tramway Committee decided that the laying of the lines should be done by direct labour, and not by contract. The work has now been completed—so the borough engineer (Mr. Bradley) now reports—at a considerable saving in the cost. The Committee have determined that the whole of the lines in the borough shall be laid on the same system.

**Continental Notes.**—*Paris.*—The cost of the recent extension of the Paris-Orleans Railway Co., on which electric traction has been in service since the middle of July as far as Juvisy, some 15 miles S-E. of Paris, amounts to over a million sterling.

It is announced that the Paris-Metropolitan Railway Co. will open their No. 3 line some time in October next. This line runs from Courcelles to Pl. Gambetta, and passes the Opera and central boulevards. The No. 4 line, running N-S, has been started at the Rue de Rennes. It will pass under the Seine in a tunnel to be started this year close to Pont St. Michel.

*St. Georges de Commiers* (*Isère*).—Some successful experiments have lately been carried out on a 500-H.P. locomotive supplied with four motors, insulated for 1,500 volts. These are used two in series, and the line tension is 2,400 volts.

*Schlucht* (*Coté d'Alsace*).—The tramway service has just been opened, and the first car mounted the 8 per cent. grade (length, 6·5 kilometres) in 20 minutes, descending within 25 minutes. Three independent brakes are used—air, electric and hand. The cars carry 20 passengers. The extension over the German frontier will soon be undertaken, and the grades will necessitate the use of rack and pinion.

*Villefranche* (*Pyrences*).—The Midi Railway Co. are asking for tenders for the electrical equipment of a new line of meter gauge, over a length of 57 kilometres. Direct current and single-phase methods will be considered, and waterfalls are available in the district for generating power. The grades do not exceed 6 per cent. The speeds must be 35 kilometres per hour over grades and 45 on the level.

*Switzerland.*—The *Feuille Fédérale Suisse*, of August 3rd, contains the text of a decree granting a concession for the construction and working of a narrow gauge electric railway from Schöftland to Sursee. The cost of the work is estimated at 1,520,000 fr. (about £60,800). The *Feuille* may be seen at the Commercial Intelligence Branch of the B. of T., 73, Basinghall Street, E.C.

**Dewsbury.**—An agreement has been come to between the Dewsbury Corporation and the Yorkshire Woollen District Tramways Co. (B.E.T. Co.) for the purchase by the Corporation of the tramways constructed in the borough by the company. The lines form part of the system connecting Dewsbury with the Spen

Valley and other adjoining districts. The length of the lines in the borough is between three and four miles. No account is taken of the rolling stock, which is retained by the company. The price to be paid by the Corporation for the lines and overhead equipment is £50,500, which represents the actual cost of construction and street widenings. Besides this sum, the Corporation will also pay a proportion of the company's costs in obtaining their order, and 20 per cent. on the total sum. When the agreement is signed and sealed, the lines are to be leased to the company for a period of 28 years at a rent sufficient to pay the interest and sinking fund on the capital outlay. At the expiration of the 28 years the company are to have the option of entering into a further lease for seven years. In the event of the Corporation desiring extensions to be carried out, and the company declining to undertake such extensions, the Corporation may promote orders to enable it to construct lines. Application is to be made for sanction to borrow the amount required to effect the purchase.

**Leith.**—The deputation appointed by the T.C. to visit a number of the principal English towns where electric tramway traction is in use with the view of deciding which is the most suitable system for adoption in Leith, returned on Monday. The places visited were Newcastle, Hull, London, Bournemouth, Birmingham, Wolverhampton, Leicester, Manchester, Liverpool, and Blackpool. The deputation will shortly submit their report, but it is understood that they agreed that the best system they had seen was that at Leicester, and they will recommend the adoption of the overhead system. They are also of opinion, however, that the artistic poles which they saw at Bournemouth should be used in connection with it.

**Liverpool.**—It is reported that several passengers were injured on 19th inst. by the fall of an overhead wire on to the top of a passing tramcar.

**Middlesex Light Railways.**—The official inauguration, on Saturday afternoon last, of the first portion of the County of Middlesex Light Railways, between Tottenham and Wood Green, attracted a large number of guests to Tottenham, where Sir Francis Cory-Wright (chairman of the Light Railways and Tramways Committee of the Middlesex County Council) performed the ceremony. The section opened connects the Wood Green and Edmonton branches of the tramways belonging to the Metropolitan Electric Tramways, Ltd., who will work the new line under a lease from the County Council, which holds all the Light Railway Orders, and has leased the lines to the company until 1930. The Hertfordshire C.C. has also arranged to lease the Light Railways it has promoted to the same company on similar terms. The Middlesex County Council's scheme embraces some 50 miles of route, it being the sole tramway authority in its area. Other sections of these light railways, which will soon be opened, comprise the four radial roads from Willesden to Wembley, Cricklewood to Edgware, Highgate to High Barnet, and Wood Green to Enfield, while cross routes will form connecting links between the trunk lines. The cost of constructing the track is borne by the Middlesex C.C., the electrical equipment and rolling stock being provided by the company. An average of 4½ per cent. on the Council's expenditure is paid by way of rent. The company receives out of the gross receipts an average of 4½ per cent. on its capital expenditure, and the net revenue, after deducting working expenses, &c., is divided between the Council and the company in the proportion of 45 per cent. to the Council and 55 per cent. to the company. The North Metropolitan Power Supply Co. will provide the electric power supply.

The guests were received at Bruce Castle Park, Tottenham, by the chairman and members of the Light Railways and Tramways Committee and the directors of the company. Speeches were made by Sir F. Cory-Wright, Mr. E. Garcke (chairman of the Metropolitan Electric Tramways, Ltd.), and Sir Ralph Littler, K.C. (chairman of the Middlesex C.C.). Special cars conveyed the visitors from Tottenham to Wood Green, *viâ* Lordship Lane and over the tramways of the Metropolitan Electric Tramways, Ltd., from Wood Green to Tottenham, *viâ* Manor House and Seven Sisters.

**Northampton.**—The B. of T. inspection of the Kingsthorpe section of the Corporation Tramways was held on Thursday last week, and the electric cars to Kingsthorpe commenced running for public service the following day.

**Perth.**—A Dundee paper says that the project of establishing an electric tramway service to the summit of Kinnoull Hill is still engaging attention. It is also considered that the proposed ascent to Kinnoull by means of electrification could be easily accomplished, and would be an immense attraction for the city of Perth. The estimated cost is £17,000.

**Pontypridd.**—The U.D.C. has decided to take expert advice as to whether the electric tramways shall be constructed and worked by the Council or leased to a company.

**Rochester.**—The Corporation new system of tramways is being pushed forward rapidly. The rails are laid on Star Hill and the New Road, and ere long the Chatham and District Light Railways Co. will join their lines to those meeting them from the New Road end and make a continuous line of route from one end of the three towns to the other, a distance of several miles. It is also intended to extend the lines on to Maidstone, Rainham, and Gad's Hill, Higham.

## TELEGRAPH AND TELEPHONE NOTES.

**Swansea Telephones.**—The *Western Mail* says that as the result of communications which have recently passed between the Swansea Corporation and the National Telephone Co. on the subject of inter-communication between subscribers, the National Co. has indicated a disposition to adopt a more conciliatory attitude. The company is, it is stated, prepared to accept the Postmaster-General's certificate, and to waive the demand for the inspection of the corporation agreements.

**The Telegraph Wire Export Trade.**—A very quiet business continues to prevail in the export trade of this country in telegraph cables and apparatus connected therewith, the shipments in July only amounting to £30,484, as compared with £52,334 in the preceding month. The slackness in this branch of trade is strongly indicated in the returns for the seven months ending with July, the exports during that period having only amounted to £543,843 as against £1,466,194 in the corresponding seven months of 1903.

**Telegraphic Cable to Iceland.**—The *Times* states that the telegraphic connection with Iceland and the Færöer, which has been desired during so many years will be established next year. The cable will be laid from Iceland, *viâ* the Færöer, to the Shetland Islands, where it will be connected with the British system. The Great Northern Telegraph Co. has the matter in hand.

### Telegraphic Interruptions and Repairs :—

| Cables. | Interrupted. | Repaired |
|---|---|---|
| Trinidad-Demerara, No. 1 | Aug. 26, 1901 | |
| Dominica-Martinique | May 7, 1902 | |
| St. Lucia-Martinique | May 7, 1902 | |
| Cayenne-Pinheiro | Aug. 13, 1902 | |
| Reissa-Issa (Yemen)-Camaran | Oct. 22, 1902 | |
| Tarifa-Tangier | Jan. 18, 1904 | |
| Dakar-Konakry | May 13, 1904 | |
| Chio-Ténédos | June 21, 1904 | |
| Paramaribo-Cayenne | July 13, 1904 | |
| Closed { Vladivostock-Nagasaki | Feb. 9, 1904 | |
| Closed { Port Arthur-Chefu | Mar. 9, 1304 | |
| Marseilles-Barcelona | Aug. 16, 1904 | Aug. 22 |
| Cape Haitien-Mole St. Nicholas | Aug. 20, 1904 | |
| **Landlines.** | | |
| Seoul-Masampo | Feb. 18, 1904 | |
| Seoul-Gensan | Feb. 18, 1904 | |
| Anju-Ping-Yang | Feb. 25, 1904 | |
| Ninguta-Vladivostock | March 2, 1904 | |
| Moulmein-Bangkok | July 13, 1904 | |
| Caimanera-Santiago | June 15, 1904 | |

**Telegraphs and Telephones.**—From the annual report of the Postmaster-General, we gather the following particulars:—During the year under review, 89,997,000 telegrams passed over the Post Office wires, as compared with 92,471,000 in 1902-3, a decrease of 2·7 per cent. The decrease is no doubt partly due to trade, and especially Stock Exchange, depression; but probably the principal cause is the growth of the telephone system. The number of telegrams was made up as follows: Ordinary, 73,827,000; Press, 6,322,000; foreign, 7,932,000; railway free, 440,000; railway reduced rate, 20,000; Government free, 446,000. The average number of words per week in Press telegrams during the year was 14,588,478, as compared with 14,890,712 in 1902-3. The total receipts from telegrams amounted to £2,755,732, a decrease of £82,697.

On March 31st last the number of Post Office telephone trunk wire centres was 396, an increase of 41 in the year. The total number of trunk circuits in use was 1,418, as compared with 1,309 in the preceding year. The number of new circuits opened for traffic during the year was therefore 109. The total length of the trunk circuits in use was 51,400 miles, containing about 102,800 miles of wire. The total number of trunk line conversations during the year was 13,467,975. The corresponding number for the preceding year was 11,574,229, and the increase in the year was at the rate of 16·3 per cent. The gross revenue from this service was £325,525, as compared with £274,835, the increase being at the rate of 18·4 per cent. The average value of each conversation was 5·8d. Seven years ago the average value was 5·02. This increase corresponds with a greater use of the trunk lines between more distant towns.

The number of telephones in connection with the Post Office London telephone system increased during the year from 9,122 to 15,632, and additional subscribers are being connected at the rate of from 100 to 200 a week.

The length of the underground pipes which had been laid in the London area on March 31st last was 1,146 miles, and cables containing 125,717 miles of wire have been provided, including 32,248 miles for the use of the National Telephone Co. on rental terms pending the transfer of the company's system to the Post Office. The lines of the present subscribers and the junction lines between exchanges have absorbed 43,335 miles; and 50,134 miles remain available for further development. On an average each circuit directly connected with an exchange has involved the provision of a mile and a half of double wire, if allowance be made for the junction lines between exchanges. The accounts for the year show a balance of £33,515 available for meeting the charge for interest on capital, and for making provision for depreciation of plant and the capital expenditure was £1,514,300.

**Wireless Telegraphy.**—An important notice respecting this Act, and the necessity for experimenters to apply for licences, is published in our advertisement pages to-day by the Postmaster-General.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Barking Town.**—September 20th. Rails, permanent way, overhead equipment, and feeder cables, for light railways extensions. See "Official Notices" to-day.

**Chelsea.**—The Guardians are inviting tenders for wiring work in connection with the Infirmary electric lighting installation.

**Edmonton.**—September 27th. The U.D.C. invites offers from companies willing to carry out its electric lighting provisional order. See "Official Notices" to-day.

**Hove.**—August 30th. Low-pressure mains, conduits, meters, &c. See "Official Notices" August 12th.

**London.**—October 4th. Three electric car traversers for the L.C.C. See "Official Notices" August 5th.

**London.**—October 4th. The L.C.C. wants tenders for centrifugal and other pumps for Greenwich power station. Particulars from Mr. G. L. Gomme, County Hall, Spring Gardens, S.W.

**Manchester.**—August 30th. Wiring and electric lighting of transit sheds at the New Dock Works. See "Official Notices" July 29th.

**Plumstead.**—Tenders are invited for an electric light installation at the Royal Arsenal Co-operative Society's, Ltd., New Branch Stores, Plumstead Common Road, Plumstead, S.E. The drawings may be seen, and a copy of the specification and other particulars, obtained at the office of the architect. Tenders are to be delivered before 12 o'clock noon on Saturday, August 27th, 1904, addressed to Mr. Frank Bethell, architect and surveyor, 23, Queen Anne's Place, Bush Hill Park, Enfield, N., and endorsed "Tender for Electric Lighting, Plumstead Common Branch."

**Roumania.**—August 27th. Tenders are being invited until the 27th inst. by the Roumanian State Railway Authorities in Bucharest for the supply and erection of the additional plant required for the supply of electrical energy for lighting and power purposes at the new railway workshops in that city.

**Spain.**—September 3rd. The Spanish Post and Telegraph Authorities in Madrid are inviting tenders until September 3rd for the supply of 70 tons of galvanised iron telegraph wire, 4 mm. diameter. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas, 10, Madrid.

**Swansea.** — September 7th. Two negative tramway boosters for the Corporation. See "Official Notices" to-day.

**West Ham.**—September 13th. Tramway poles, fittings, wires and fittings for the Council. See "Official Notices" to-day.

**Worksop.**—August 29th. Underground cables for the U.D.C. See "Official Notices" August 19th.

### CLOSED.

**Bradford.**—The Sunbeam Lamp Co.'s tender for the supply of their specially constructed car lamps has been accepted.

**Dewsbury.**—The Corporation has decided to accept the tender of Messrs. J. & J. Horsfield, of Dewsbury, for the supply and fixing of a boiler at the electricity works, at a cost of £620.

**France.**—The French Post and Telegraph Authorities in Paris have just placed contracts as follows:—La Compagnie Generale d'Electricité, of Paris, 45 tons of bronze wire, $1\frac{1}{10}$ mm. diameter, at 2,525 fr. per ton; La Compagnie Française du Bimetal, Paris, 30 tons of high conductivity copper wire, 2 mm. diameter, at 1,920 fr. per ton; La Compagnie Française des Metaux, Paris, 100 tons, ditto, $2\frac{1}{2}$ mm. diameter, at 1,925 fr. per ton; Les Trefileries du Havre, 100 tons, ditto, at 1,927 fr. per ton; Les Forges du Franche Comté, Besançon, 50 tons, ditto, at 1,925 fr. per ton; Les Mines et Fonderies de Pontgibaud, Paris, 50 tons, ditto, at 1,927½ fr. per ton; La Société Metallurgique de Dives, Paris, 50 tons, ditto, at 1,897½ fr. per ton; and M. Grammont Pont de Cherny, 50 tons, ditto, at 1,927½ fr. per ton.

**Heckmondwike.**—The U.D.C. has accepted the tender of Messrs. E. Green & Son, for additions to the economiser at the E.L. works.

**London.**—The following list of tenders has been received for electric lighting installation, mains in iron barrel, power supply, &c., for the Bell Lane Free Schools, to the specifications of the consulting engineers, Messrs. Owen Lucas & Pyke, of Victoria Street, S.W. The architect is Mr. E. R. Robson:—

| | |
|---|---|
| Drake & Gorham, Ltd. | £1,814 10 |
| Hampton & Sons, Ltd. | 1,709 0 |
| Smith, Walker & Co. | 1,706 10 |
| Belshaw & Co. | 1,670 11 |
| Leo Sunderland & Co. | 1,498 10 |

Leo Sunderland & Co.'s tender has been accepted.

**Salford.**—The T.C. has accepted the tender of the British Westinghouse Co. for the supply of electrical and mechanical car appliances.

**Spain.**—The Sociedad Mengemor has placed the contract for the plant for its central electric power station at Ohanes with the Oerlikon Co., of Oerlikon, Switzerland. The plant will comprise two 170-H.P. turbines and two alternators, each of 150-KW. capacity.

## NOTES.

**American Visit of the I.E.E.**—The following is a list of the names of members who are known to be taking part in the tour. The President and secretary went on a week in advance:—

** An asterisk is placed before the names of past Members of Council.*

*† Denotes those sailing on the "Republic."*

†Gray, R. Kaye (*President and Delegate.*)
†Crompton, R.E., Lieut.-Col., C.B. (*Past President and Delegate.*)
†Perry, Prof. John (*Past President and Delegate.*)
†Glazebrook, Dr. R. T. (*Member of Council and Delegate.*)
†Gripper, F. E. (*Member of Council.*)
†Hammond, Robert (*Hon. Treasurer and Member of Council.*)
†*Harrison, H. E. (*Delegate.*)
†*Duddell, W. (*Hon. Sec. to the Institution Delegation.*)

†Atchison, A. F. T.
†Balfour, George.
†Ball, R. S.
†Barnes, W. A.
†Bates, D.
†Blair, G. Conrad.
Blennerhassett, R.
†Connolly, John T.
Cormack, Prof. J. D.
†Dick, J. R.
†Edgar, James.
†Erskine, R. S.
†*Fawcus, W. P. J.
†Feilden, T.
†Foster, J. A.
†Geipel, W.
Goldsborough, Prof. W. E.
Handcock, E. C.
Harris, W. A.
†Hawkins, C. C.
†Hayashi, M.
Hering, C.
†Hesketh, Thomas
Higman, O.
†Hope-Jones, F.
Insull, S.
†Jennison, M.
Kennelly, Dr. A. E.
Kernot, W. N.
†Kidman, F. C.
Knight, J. D.
†Liebert, E. H.
Lloyd, G. C. (*Secretary.*)
†Long, F. M.
†Longbottom, B.
†McLeod, R. S.
Mailloux, C. O.
†Marr, J. L.
†Marr, W. B.
†Marshall, J.
†Matthews, R. B.
†Mills, F. O.
†Morris, Dr. D. K.
†Morris, J. T.
Morrison, A. E.
†Morse, L. G. E.
†*Nalder, F. H.
Nichols, F.
Owens, Prof. R. B. (*Local Hon. Sec., Canada.*)
†Perring, R. B.
†Pope, W. G. T.
†Pyne, A. P.
Rice, Calvin W.
†Risch, G. H. C.
Schattner, E. B.
Scott, E. Kilburn.
†Scott, W. H.
†Sheardown, P. S.
Simons, H. B.
Summerscales, W.
†Taite, C. D. (*Chairman, Manchester Local Section.*
Thomson, Prof. Elihu
†Tilney, M. J. E.
†Tree, R. (*Chief Clerk.*)
Wallwin, J. M.
Ward, G. G. (*Local Hon. Sec. for U.S.A.*)
Webb, A. C. F.
†Whiting, H. G.
†Wilkinson, G.
Willis, Capt. R. Ft.
Wilson, L.
†Woollan, E. B.

All letters, &c., should be addressed to members "care of Mr. Ralph W. Pope, secretary, American Institute of Electrical Engineers, 95, Liberty Street, New York"—up to September 14th. The telegraphic address of the party is "Voltampere, New York," to which the name of the addressee should be prefixed. The form should be marked "*vid* Commercial."

**Fatality.**—An inquest was held at Westminster on 16th inst. respecting the death of a girl of twelve named Reeves, which occurred on 15th inst., by the falling of a bracket supporting a telephone wire at Sloane Gardens, Sloane Square. A solicitor for the National Telephone Co. said the wire belonged to the company, and they were anxious to facilitate the inquiry. Mr. Brown, the district engineer of the company, stated that the wire was put up prior to 1894. Brackets and wires were examined every six months, but he had no record of this particular bracket having been examined. The wire was a private one, and had been in use since 1900. As soon as the company were informed that wires were not required, orders were given for them to be removed, but the engineers had forgotten about this one. The order was issued during his predecessor's time. The solicitor: The Postmaster-General can put down wires and rip up streets, yet the National Telephone Co. are in the unfortunate position of being compelled to attach all their wires to the houses. The jury returned a verdict of "Accidental death," and expressed the opinion that there had been gross negligence on the part of the company in not having the wire removed. The solicitor said that the company would do their utmost for the relatives of the deceased.

**British Municipal Visit Abroad.**—On Saturday a party of 150 members of British municipal authorities left King's Cross for Hull, where they embarked in the steam yacht *Argonaut*, which left in the evening for Christiania, on a cruise to the northern capitals of Europe. At Stockholm the party will visit the telephone company's station. They will also visit gas, water, and electricity works.

**The Tramways and Light Railways Association.**—The official circular of the Association announces that a lecture on "Automatic Regenerative Control for Electric Traction" will be delivered by Mr. John T. Hall, manager, Raworth's Traction Patents, at the Society of Arts, on Thursday, October 20th, at 8 p.m. The Association is making arrangements for visits to works and electrical installations in and around London during the autumn and winter months.

**International Competition.** — A competition with prizes varying from 6,000 fr. downwards is opened by the Association des Industriels de France, 3, Rue de Lutèce, Paris, for a portable instrument for the use of workmen and others handling electric cables. The apparatus is to indicate the state of any cables or wires with which it is placed in contact. The competition closes at the end of 1904, and particulars may be obtained from the President of the Association.

**South African Notes** (from our Durban correspondent).—*East London* (*Cape Colony*).—The receipts from the municipal tramways for the year ending June 30th, 1904, show a revenue of £7,625, against £7,502 for the preceding year, being an increase of £123.

*Potchefstroom* (*Transvaal*).—At a meeting of the Potchefstroom Town Council on July 22nd, it was reported that the Council in Committee had been considering the buying of the plant and property of the local electric lighting company. The cost of street lighting to the Council worked out at about £1,000 per year. The matter is being further considered.

*Pietermaritzburg* (*Natal*).—At the Pietermaritzburg Town Council meeting on July 26th, it was reported that a committee of the whole Council having had under consideration the question of the position of the consulting electrical engineers in England, recommended that the resignation previously tendered by them be accepted. It was decided to adopt the recommendation, but a rider was added that the committee be instructed to report upon the advisability of engaging fresh consulting electrical engineers.

*Port Elizabeth*.—Mr. A. G. Knight, of Port Elizabeth, has secured a contract for installing a system of intercommunication telephones throughout the new Administrative Offices of the Harbour Board.

Messrs. Reunert & Lenz having resigned the agency for Parsons' turbo-electric machinery, Messrs. C. A. Parsons & Co. have opened an office in Johannesburg, for the transaction of South African business. Their address is Howard Buildings (corner Loveday and Main Streets), and Mr. James Golder is their resident engineer. Messrs. Parsons have already about 12 sets of turbo-generators in the country ranging from 50 to 1,000 KW., and as electricity is going to play a very prominent part in the development of the gold mining industry, these turbines promise to be much in demand.

**Electricity Works Statistics: Addenda:—**

GRAVESEND.—Add 2 Lanc. boilers, 4-cell Hughes & Stirling destructor, 1 Belliss engine and Brit. Westinghouse generator. Total capacity, 700 KW.; max. load, 500 KW. Battery max. discharge, 300 KW. Total capital outlay, £50,000. Public and private ltg., 10,580 8-C.P. lamps. Traction, 250 KW. Prices charged, pr. ltg., 7d. and 2d., or 5d.; public ltg., ½-amp. Nernst £3·5 per annum, arcs 3d. per unit; power and heating, 2d., or two-rate meter, 1d. and 5d.; traction, 2d. first 180,000, 1½d. to 350,000, 1¼d. beyond. Total units sold, 588,595. Av. price obtd., pr. ltg., 4·36d.; public ltg., 2·79d.; tr., 1·83d. Works and distribution costs, 1·59d.; total costs, 1·81d. per unit.

**Electric Coal-Cutting.**—In his presidential address to the British Society of Mining Students' meeting at Newcastle last week, Mr. Sidney A. Smith said that during the last few years great progress had been made with regard to the use of coal-cutting machines. Where the conditions as to the nature of the seam and the floor had been favourable, the use of coal-cutting machines had shown that coal could be got by them at less cost than by manual labour, and there was no doubt that, owing to the high price of colliers' labour and to competition generally, their use would become more general, particularly in the case of thin seams and in deep workings. The chief point in considering the working of deep mines would appear to be the increased temperature of the strata due to depth. This question of temperature might have a considerable effect in deciding the question whether compressed air or electricity should be used for driving coal-cutting and other machines in deep workings.

**Electric Shock Fatalities.**—On 17th inst. an inquest was held at Tynemouth respecting the death of James Harris (19), a trespasser on the Tynemouth electrified section of the N.E. Railway. A verdict of "Accidentally electrocuted while trespassing" was returned. On the same day a young lad climbed over a fence of Messrs. Swan & Hunter's shipyard, near Carville Station, and tripped on both "live" rails. He was pulled off the rails, and brought round by artificial respiration.

On 21st inst. a horse which had strayed on to the N.E. Railway between Walker Gate and Wallsend, was electrocuted. One of his fore hoofs and legs was completely severed.

On Monday afternoon Mr. Walter Schroder, Deputy Coroner, held an inquest at the Marylebone Coroner's Court, with reference to the death of C. W. Saunders, aged 21 years, a labourer in the employ of the Metropolitan Electric Supply Co., who was killed by an electric shock received at Manchester Square, Marylebone, on Friday last.

Mr. Barlow represented the Metropolitan Electric Supply Co., whilst Mr. Gunnel represented the Marylebone Borough Council.

Edward Pearce, foreman of labourers in the employ of the Metropolitan Electric Supply Co., stated that on Friday morning they were at work at Manchester Square in taking out old mains and putting in new mains, deceased and other men having done similar work before. About five minutes to eight he was 100 yards away from deceased when he heard a shout of alarm, and on going to the spot saw deceased lying on the pavement. The other men seeing that he had evidently received an electric shock at once used means to restore him by artificial respiration. Deceased simply moved his lips and expired. There was another man named Hennessey at work in the same hole at the time of the accident, cutting the pipe. Witness five minutes before had given them instructions as to how to cut the pipe, because it enclosed a live main. The reason for cutting the pipe was to put in a new box. Such work was proper work for a labourer to do without any supervision. He would use for the work a hammer and chisel. It was customary to cut the pipes whilst the electric current was on. Men were not supplied with gloves whilst doing such work, nor were the tools that they used protected in any way. He had gloves there which were used for paying the cable in. The work was being carried on in the ordinary way. He knew of no better way of carrying on this kind of work. He did not think when cutting the pipe that he would cut the cable. The cable would be ⅜ in., and it was not to be cut. The piping was of iron. The pipe having been cut, the deceased had driven the wedge too far when striking it, and it came into contact with the cable. Deceased was supposed to be able to see when he should cease to strike the wedge. The cable was insulated. The man would have to hold the wedge with his hand. He did not think that it was necessary to have a non-conducting band on the wedge. After the accident he found the wedge was in the pipe where the pipe was being cut. The cable had been cut, which accounted for the deceased receiving the shock that he had. At times he had found that the wedge would slip when getting near to the end and go to the cable. He had never known a similar accident to this, although this kind of work was done daily. There was nothing to prevent the chisel going down to the cable should the pipe give way suddenly. Another man received a slight shock. He did not know whether the manholes in the district had become alive. A juryman said that it was known that some manholes had become alive and a horse had been killed. Another juryman asked whether this accident would have occurred if gloves had been used. The witness said he could not say.

John Hennessey, a labourer, said that he and deceased on Friday morning commenced to work in a manhole at Manchester Square in the ordinary way. Deceased was at work cutting the pipe, and to do so he used an iron chisel, after which he would place in a bursting wedge. Having put in the wedge, he struck it twice with the hammer, and the last time he struck it he called out "Oh!" and fell back against witness, and rebounded on to the pipe. Witness received a slight electric shock. He got out of the manhole, and saw deceased lying on the pavement, and he died directly afterwards. The method used by them to break the pipe was the usual way. He had never known a wedge to go into the cable before. He believed the safest method in breaking a pipe was to keep the wedge in a slanting position, instead of upright as the deceased had it.

Mr. Thomas Richard Allison, ex M.R.C.S., of Spanish Place, said that he was called, and found deceased was dead.

Dr. Frederick William Spurgen, of 35, Welbeck Street, W., police surgeon of the D division, stated that he had made a post-mortem examination of the body of the deceased, and found that death was due to an electric shock, stopping the heart's action. He went to see the spot in Manchester Square, and saw an excavation 3 ft. deep, and at the bottom was a pipe with a wedge in an upright position. It occurred to him that the handle of the hammer, and also the part of the chisel that the workman took hold of, should be covered with india-rubber. It would certainly be better if the men wore india-rubber gloves.

Mr. James William Drew, superintendent of mains for the Metropolitan Electric Supply Co., said that this work was being carried out in the usual manner. The men would first chip around the pipe, and after that the wedge would be placed in. Since this occurrence they had placed this work in the list of dangerous operations, and the foreman was now responsible to see that the men did not work without rubber gloves. It would require a heavy force to pierce the cable. They had never before had a damaged cable. The voltage of the cable was slight, being only 500 volts.

The Coroner summed up the case at some length.

The jury returned a verdict of "Accidental Death," and added a rider, that the attention of the company should be called to this case with a view to preventing similar occurrences in future.

**Large Testing Machine for the University of Illinois.**—A testing machine to deal with 600,000 lbs. has been constructed by the firm of Riehlé Bros., of Philadelphia, for the above university; it is claimed to be the largest screw-power testing machine ever built. The machine is adapted to deal with compression specimens up to 25 ft. in length, tension specimens up to 22 ft., transverse specimens 10 ft. long × 3 ft. wide; the extreme height of the machine is 36 ft. 8 in., and it covers an area of 17 ft. × 10 ft. 8 in., including the space taken up by the 15-H.P. electric motor, which furnishes the driving power. The machine is provided with two heads, the upper one supported on vertical columns, bolted to the weighing table. The lower, or pulling head, is driven by two main vertical screws, and the top head is adjustable according to the length of specimen to be tested, the weighing and stress transmitting mechanisms being quite distinct. The motor will drive the machine up to full-load at speeds not greater than 1 in. per min., and up to half-load at 2 in. per min. A hydraulic buffer is provided for taking the recoil due to the breaking of a specimen. The machine is intended for general testing, and columns, beams, irregular shapes, reinforced concrete, stone and brick construction, built-up trusses, &c., all come within its scope of work.

**Standardisation.**—That the standardisation of machines is not the simple matter it is lightly held up to be sometimes, is shown by some recent remarks in the *American Machinist* upon an opinion expressed by a representative of a foreign firm, that in a certain direction American competition need not be feared for ten years, because American manufacturers were so tied up to their standards as to place them out of the field in the direction indicated. This result, no doubt, is to be feared where standardising is carried too far. Possibly, Americans have gone too far in standardising whole machines, and this may explain what is so palpable to outsiders, and so invisible to themselves in their very uneven practice. They are apt to stick to standards too long. On the other hand, we have erred in the other direction, and have

compelled manufacturers to make special patterns for paltry details rather than allow them to use their own patterns, even when practically identical with drawing. Why should not a 10-in. hand-wheel be the same for all purposes requiring a 10-in. wheel?

A hand-wheel is not to be proportioned to do a certain work, but to be capable of withstanding the strength of a man. If more pressure is required to be brought upon the work, the diameter of the wheel should be altered. A 12 or a 15-in. standard is then required. There are thus two sorts of standard, the detail and the general, and it is in fixing general standards that most care is needed, for, as our contemporary points out, standardising is undoubtedly restricted, is restricting, and will in the future restrict development that would otherwise take place. Our contemporary's advice to manufacturers is that they should have a special department in which they should undertake to build odd things; such odd work would not then throw the regular line of shop work out of order. If odd work is sent through a regular manufacturing shop, it upsets the even running of the whole establishment, and increases costs all round. In a special or odd shop it would be easy to find out just how much the odd jobs did cost, and this class of work would bring in new ideas, as well as affording opportunity for experiment and research. Standards, when once fixed, are not to be departed from easily, and progress must be put back.

As one instance only of what a standard will effect, the railway gauge of 4 ft. 8½ in. is cited; no amount of demonstration of the greater advantages of 3-ft. or 9-ft. railway gauges would upset the standard gauge, which irrevocably ties us to the past. Tramway men have ignored the standard gauge by many inches; some of them of more particularly low intelligence have ignored standard gauge by about an inch. In time, probably all will come to one gauge. Seeing that the narrow-wheeled tramcar cannot be run safely on a regular railroad, it would seem that, if there is to be any interchange of vehicles, the tramway gauge should measure 4 ft. 8½ in. between rails, not between outside of grooves. This one item alone shows the difficulties that constantly crop up in fixing standards.

**Coke Ovens and their Relation to Electrical Power.**—In a paper read on April 18th, 1904, before the Cleveland Institution of Engineers, Middlesbrough, by Paul J. Mallmann, the author reviews the history of coke making from the seventeenth century to the present date, chiefly referring to the various patents taken out during that period. It is interesting to find that the question of recovering the bye-products was included in a patent granted to the Earl of Dundonald as early as 1781.

An important feature of the paper, as it is issued, is the size of the sheets, 14⅝ in. × 10 in., which allows of the various illustrations being reproduced on a scale which is convenient for studying the details. The illustrations include 17 systems of coking coal. The recovery of bye-products and the products of the bye-product recovery coke ovens are next dealt with; but these, with the exception of surplus gas, are not of much interest to our readers. In regard to the value of the bye-products, the author says: "The annual amount of coal, coked to obtain metallurgical coke in this country is about 50,000,000 tons. This coal contains at least 15 to 20 per cent. of volatile matter," and "half of the gas that leaves the condenser is available."

Now, as coke oven gas is rapidly being turned to account for generating power in internal combustion engines for electrical and other purposes, this alone is sufficient to attract the attention of electrical engineers. Taking the author's statement that half the gas evolved from coke ovens should be available for power purposes, a rough calculation shows that if used in gas engines, the surplus gas would be capable of developing over 1,000,000 H.P. continuously, while at the present time only a small proportion of this surplus gas is turned to account for raising steam in boilers.

In conclusion, the author points out that while between the dates of 1620 and 1875, almost all patents for coke ovens were of British origin, since the latter date to the present, practically every patent for modern bye-product recovery ovens has been taken out by foreigners; to quote the author:—"This victory of the foreign engineer is a purely intellectual one. Excuses, such as 'dumping,' cheaper labour of the foreigner, protection, or similar explanations for the defeat of the British engineer, cannot be brought forward. Here no excuse is possible, the plain facts are incontrovertible."

**Electricity in Mines.**—A paper dealing with the advantages of electricity as a motive power in collieries was read before the Manchester Geological and Mining Society by Messrs. P. C. Pope and Norman D. Cameron on 9th inst. The paper dealt with practical comparisons of direct-current and polyphase systems as applied to British collieries, and the conclusions arrived at were in favour of a three-phase alternating-current system. The general discussion by the members was deferred to a subsequent meeting.

**Anglo-American Traction Journal.**—The well-known English journal *Transport* has entered into arrangements with the *Railroad Gazette*, of the United States, whereby, under the title *Transport and Railroad Gazette*, the most valuable features of both are combined in a weekly issue. The London office is at Queen Anne's Chambers, Westminster. The inauguration of this strong combination was celebrated by a special number containing a large variety of illustrated and other articles of exceptional interest, amongst which we may mention the electrification of the North-Eastern Railway. We cordially congratulate the editors both upon their sound judgement and enterprise in effecting this welcome alliance and upon the excellence of the journal which they have produced.

**The Behaviour of Certain Metals in Sea Water.**—An account of some experiments, which lasted 32 months, on the behaviour of certain metals and alloys in sea water, and on the effect of galvanic action in the preservation of certain metals and alloys, has been published recently by Herr Diegel in *Stahl und Eisen*. The substances tested were alloys of copper with nickel, and of copper with zinc, also samples of iron containing more or less phosphorus, and more or less nickel. Alloys of copper and nickel, containing 20 and 42 per cent. of the latter metal, suffer but little in sea water; if they are kept in contact with iron, corrosion is prevented. Other copper alloys kept in contact with these copper-nickel alloys deteriorate considerably. Alloys of copper and zinc kept in contact with copper itself are attacked like other copper alloys; if the proportion of zinc exceeds 28 per cent., the corrosion is greater. An addition of 15 per cent. of nickel materially increases the permanence of the alloys, even those containing 40 per cent. of zinc. All copper alloys exposed to the action of sea water in contact with iron are almost entirely protected thereby. Pure (electrolytic) copper is destroyed more quickly than the impure metal, especially that containing arsenic. Partly oxidised or ignited copper is very rapidly destroyed. Zinc protects it only for a short time, iron incompletely. When two specimens of iron containing different quantities of phosphorus are plunged into sea water in mutual contact, a galvanic element is produced in which the metal containing the larger proportion of phosphorus acts as cathode, and is more or less protected at the expense of the iron containing the smaller proportion. Nickel-steel, similarly exposed to sea water in contact with iron free from nickel, but rich in phosphorus, is almost completely protected by the latter. Nickel-steel containing 30 per cent. of nickel is also distinctly negative to steel containing 6 per cent. Generally speaking, too, nickel-steel is less easily attacked than steel free from nickel.

**Cost of Electric Trolley Buses.**—The *Western Electrician* publishes some interesting figures relating to trolley buses supplied by the General Electric Co., of Berlin. From these we gather that an overhead trolley 'bus holding 22 passengers, used about the same amount of energy as an ordinary street tramcar with a capacity of 28 persons. Under comparable conditions the trackless routes took some 25 per cent. more energy than an ordinary street car service; maintenance and repairs were also, as might be expected, much above the normal, these items being balanced by the absence of track repairs and upkeep. The cost per kilometre of a track road is about $20,000 to $30,000, as compared with $3,750 to $5,000 in the case of a trackless road. In operation the total costs per kilometre amounted, on one route, to 5 cents, compared with 5·17 cents, the actual costs to the Great Berlin Street Car Co., and to upwards of 6·25 cents on other tramways. In the case of a trackless route in the Bila Valley, after three months' working, it was reported that although the cost of energy was twice that of a track road, this excess cost only amounted to one-tenth of the sum which track roads require for interest and maintenance. It is also pointed out that from a legal point of view, the trackless route has many advantages, owing to the less stringent conditions of working.

**Electrical Laboratory for Preston.**—Messrs. Dick, Kerr & Co. have forwarded to the Secretary of the Harris Institute, at Preston, a cheque for £500 for the purpose of completing the equipment of the electrical laboratory at the Victoria Technical School. A sum of £2,500 for the same purpose has already been given by the trustees of the late Mr. J. B. Booth; and the Council of the Institute will now be able to finish the equipment.

**Portable Drill and Ram.**—The P.L.M. Railway Co. have had in use for about a year a portable generating group, running on the tracks, together with necessary wiring and portable drills for drilling sleepers for placing and fixing ties and chairs. The machine also operates electric rams for ballasting the track. Several more machines, which have proved a great success, are on order, and it is stated that they are great labour savers.

**Electro-Deposition of Metals.**—Writing in the *Moniteur Scientifique* lately, Prof. R. Namias recommends the following baths for the electro-deposition of the respective metals and alloys:—*Nickel:* Crystalline nickel sulphate, 40 grammes; ammonium chloride, 25 grammes; boric acid, 10 grammes; citric acid, 10 grammes; water, to 1 litre. The boric acid in the bath is stated to exert a very favourable influence. *Silver:* To the ordinary bath, which is prepared by dissolving freshly precipitated silver cyanide in a solution of potassium cyanide, the author adds a little potassium cyanide and some mono-potassium citrate in the state of powder at regular intervals. *Copper:* The author finds that the baths which contain cyanides work best, and are suitable for all metals, but the excess of cyanide should not be too great. The addition of a sulphite is very advantageous. The final bath should contain an excess of alkali, but only in the form of ammonia or ammonium carbonate. The acetate is the best copper salt. The author's favourite formula is—Solution A: Normal copper acetate, 30 grammes; crystalline sodium sulphite, 30 grammes; ammonium carbonate, 5 grammes; water, 500 grammes. Solution B: Potassium cyanide of 98 or 99 per cent. strength, 35 grammes; water, 500 grammes. These solutions are prepared by warming, and when A is hot, B is poured into it. *Brass:* The following is a good bath—Copper acetate, 50 grammes; dry zinc chloride, 25 grammes; crystalline sodium sulphite, 250 grammes; ammonium carbonate, 35 grammes; potassium cyanide, 110 grammes; water to 3 litres. *Gold:* The best bath is obtained by precipitating a solution of pure brown gold chloride with ammonia, and dissolving the gold fulminate in a 1 per cent. solution of potassium cyanide. The

liquid is then brought to the boiling point. The amount of gold must be at least 1 gramme per litre. If a red deposit of gold is required, 0·5 gramme of copper acetate is added for every 1 gramme of gold present. *Platinum:* The best salt to use is potassium chloroplatinite (potassium platinous chloride), at least 2 grammes of the ordinary commercial product being dissolved by itself in 1 litre of water. A solution of potassium platinic chloride, heated with normal potassium oxalate may also be employed, but should be prepared some time before it is needed. *Steel:* The author's bath is—Pure crystalline ferrous sulphate, 40 grammes; ammonium chloride, 100 grammes; water to 1 litre. It is advantageous to add 100 grammes of ammonium citrate to this bath, in order to prevent the precipitation of a basic iron salt, especially at the anode.

**Appointments Vacant.**—Assistant electrical engineer for Lagos (£300 and quarters); station superintendent for Ilford (£150).

**Electrical Matters at Newport.**—The *Western Mail* says that the Electricity and Tramways Committee of the Newport Corporation is about to investigate a series of statements which, it is alleged, have been made by an official of the Corporation, implying, as it is thought, that there has been a large amount of unnecessary expenditure. It is felt that the whole matter will in some form have to come before the Town Council.

**An Italian Aluminium Factory.**—A company entitled the "Societa per la Fabbricazione dell 'Alluminio" has been founded in Rome for the manufacture of aluminium by the electrolytic process. The Societa Italiana d'Elettrochima, the Dresden Bank, and the firm Beer, Sondheimer & Co. are said to be chiefly interested in the new venture. The power required in the reduction is to be obtained from the Val Pescara, and the raw material from the beds of alumina at Lecci die Marsi, in Abruzzo.

**The Manufacture of Calcium Carbide.**—W. S. Horry has assigned to the Union Carbide Co., of Niagara Falls, his U.S. patent for a method of heating substances which are electrolytes in such fashion as to avoid loss by electrolysis. The idea in this process is to employ an alternating current of high frequency, *e.g.*, one in which the alternations exceed 133 per second. For the manufacture of calcium carbide, a mixture of a calcium compound and carbon is melted in the manner described.

The Thusis Carbide Factory, which belongs to the "Lonza" Co. that owns two other works in Switzerland, viz, those in Valais and at Lauterbrunnen, was brought into operation again at the end of July, after several alterations and enlargements. A new electrical furnace has been erected by a Swedish engineer, but the details of its construction are kept strictly secret. It is stated to produce calcium carbide of very high quality. The Thusis factory is now able to turn out about 4 metric tons of carbide per 24 hours.

## OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.*]

**Central Station Engineers.**—The Heckmondwike U.D.C. has offered Mr. G. H. Carter, its electrical engineer, an advance of £50 a year if he will remain with the Council two years. Mr. Carter, who is now in receipt of £200, was successful in his application for the post of electrical engineer to the Acton (Middlesex) District Council, the salary being £200 plus house, coal, and light. He is reported to be considering the offer of the Heckmondwike Council.

The E.L. Committee of Portsmouth T.C. has recommended the Corporation to increase the salary of Mr. W. S. Foale, superintendent of the electric light station, from £300 to £400 per annum.

There were 182 applications for the post of electrical engineer to the borough of Weymouth, at a salary of £250 per annum, increasing yearly to £300. Mr. R. G. Simpson, chief assistant engineer, Edinburgh Corporation, was appointed.

**General.**—Mr. G. H. C. Risch, electrical engineer to the Central South African Railways, who is at present on six months' leave from South Africa, and left yesterday for St. Louis with the I.E.E., wishes us to mention that as he is on an unofficial visit to this country, it is quite impossible for him to answer the great number of business communications which he has received, and he begs that no more may be sent to him. We sympathise with Mr. Risch in the difficulty which he has experienced in preserving his *incognito*.

Mr. H. G. Cheesman, Associate of the Society of Telegraph Engineers, has been appointed superintendent of the Durban branch of the Eastern Telegraph Co. in the place of Mr. Carlisle resigned.

Mr. F. C. Gibbons, M.I.E.E, who was formerly for many years associated with Messrs. Browett, Lindley & Co., Ltd., of Patricroft, as one of their managing directors, but who severed that connection a year ago to join Messrs. Howden & Co., has now returned to Messrs. Browett, Lindley in the capacity of sole managing director.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Northern Counties Electricity Supply Co., Ltd.** (67,924).—Issue on August 4th of a mortgage debenture for £500, part of series created February 18th, 1904, to secure £100,000, charged on the company's undertaking and property, present and future, except uncalled and unpaid capital. Holder: Admiral H. J. Carr, Heathlands, Longcross, Chertsey. No trustees. Previously issued of same series, £25,600.

**Guildford Electricity Supply Co., Ltd.** (36,725).—Re-issue on July 6th of £1,600 debentures, part of series created November 19th, 1900, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series, £15,000.

**British Westinghouse Electric and Manufacturing Co., Ltd.** (63,919).—A trust deed dated August 2nd, 1904 (supplemental to trust deeds dated February 18th, 1902, and August 31st, 1903, respectively), securing a further £225,000 debenture stock created by board resolution of July 22nd, 1904, has been registered. Property charged: Freehold hereditaments at Stretford and Barton-on-Irwell, Lancs, lately forming part of the Trafford Park Estate, with buildings erected or in course of erection thereon (subject to certain rent charges affecting the same) and the company's general assets, present and future, including uncalled capital. The above is the same property as is charged by the trust deed of 1902. Trustees: Merchants' Trust, Ltd., 63, Cornhill, E.C.

**General Heating and Lighting Co., Ltd.** (80,390).—Issue on August 9th of £1,000 first mortgage debentures, part of series created March 24th, 1904, to secure £10,000, charged on the company's undertaking and property, present and future. No trustees. Previously issued of same series, £2,000.

**Moelline Co., Ltd., mechanical and electrical engineers,** London (76,629).—Issue on July 13th of £375, and on July 20th of £125 debentures, part of series created March 29th, 1904, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital (if any). No trustees. Previously issued of same series, £12,375.

**Davies, Kent & Stewart, Ltd., electrical accessory manufacturers,** London (81,627).—Issue on August 4th of £1,050 debentures, part of series created July 26th, 1904, to secure £1,350, charged on the company's undertaking and property, present and future, including uncalled capital (if any). No trustees. No previous issue of same series.

**H. Greene & Sons, Ltd. (electrical and gas engineers,** London) (58,554).—£4,000 debentures dated July 30th, 1904, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. Holders: J. and B. Horton, of 41, Colmore Row, Birmingham, and the London and County Banking Co., Ltd., 21, Lombard Street, E.C.

**Woking Electric Supply Co., Ltd.** (46,175).—Issue on July 16th, of £500 debentures, part of series created November 2nd, 1899, to secure £25,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series, £24,150.

**National Electric Construction Co., Ltd.** (53,364).—A mortgage or charge dated August 4th, 1904, to secure £20,000, has been registered. Property charged: The company's undertaking and property, present and future, including uncalled capital. Holders: R. H. Benson and H. A. Vernet, 66, New Broad Street, E.C.

**Electromobile Co., Ltd.** (75,139).—A mortgage dated August 10th, 1904, to secure £3,500 and further advances up to £10,000, has been registered. Property charged: 15 per cent. of any moneys payable to the company under contracts for sale of automobiles or for garage, supply of electricity, or other services (not including moneys payable exclusively for tire maintenance). Holders: North of England Trustee, Debenture, and Assets Corporation, Ltd., 45, Spring Gardens, Manchester.

**Urban Electric Supply Co., Ltd.** (57,986).—A trust deed dated July 28th, 1904, and a disposition of even date, to secure £200,000 first mortgage debenture stock, have been registered. Property charged (by trust deed): Electric lighting and tramway undertakings, certain freehold and leasehold hereditaments, and the company's undertaking and property, present and future, including uncalled capital; (by disposition): freehold property at Hawick. Trustees: Merchants' Trust, Ltd., 63, Cornhill, E.C.

**Telephone Co., of Egypt, Ltd.** (17,284).—A trust deed dated July 27th, 1904, to secure £60,000 debenture stock, has been registered. Property charged: The company's undertaking and property, present and future, except uncalled capital (as a floating security). Trustees: Sir A. Colvin, Earl Soham Lodge, Framlingham, and G. F. Braithwaite, Kendal, Westmoreland.

**South Lancashire Electric Traction and Power Co., Ltd.** (67,974).—An agreement dated December 23rd, 1904, and a letter of demand dated July 1st, 1904, relating to an exchange of prior mortgage debenture stock for first mortgage debenture stock, securing £47,000 (the amount originally represented by the first mortgage debenture stock, under a trust deed dated January 28th, 1901), have been registered. Property charged: Shares in the South Lancashire Tramways Co., and the Lancashire Light Railway Co., certain lands and hereditaments afterwards acquired by this company, and the company's other assets, present and future, including uncalled capital. The charge contained herein will be the same (but ranking in priority thereto) as that raised in respect of the first mortgage debenture stock which was secured by the said trust deed. Trustees: Electric Conversion Syndicate, Ltd., 13, St. Helen's Place, E.C.

**Bath Electric Manufacturing Co., Ltd.** (78,083).—Issue on August 15th of £300 debentures, part of series created July 19th, 1904, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital, if any. No trustees. No previous issue of same series.

**Fleetwood and District Electric Light and Power Syndicate, Ltd.** (49,666).—A charge dated August 16th, 1904, to secure £500 and further advances up to £700 (created under authority of the High Court by W. Cash, the Receiver appointed by the Court), has been registered. Property charged: All the company's undertaking and assets (in priority to trust deed dated October 1st, 1899, and certain subsequent debentures created or issued thereunder. Holder: W. C. Johnson, 32, Hyde Park Gardens, London.

**Electrical Fittings Co., Ltd.** (81,756).—£2,400 debentures, created August 15th, 1904, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees.

**West African Telegraph Co., Ltd.** (21,626).—This company's annual return was filed on July 1st, when 28,109 shares had been taken up out of a nominal capital of £400,000, in 40,000 shares of £10 each £281,090 has been received. No mortgages or charges.

## ELECTRICITY SUPPLY ACCOUNTS.

**Nottingham Municipal Electricity Supply.**

We give herewith the returns of the Nottingham Electricity Department for the past year. It will be seen that substantial progress has been achieved all round, and that a handsome surplus, amounting to over £12,000, resulted from the year's operations.

The working costs, though still low, are, no doubt temporarily, a trifle higher than those of the previous year; the surplus is the largest earned so far, in a year's working, and it has been apportioned as to £6,000 in aid of the rates, and the remainder to the reserve fund.

The prices charged are:—Private lighting, maximum demand system, 5d. and 1½d.; power, 1½d.; and traction, 1¼d. per unit. The chief engineer is Mr. H. Talbot.

### General Statement.

| For year ending March 31st— | 1904. | 1903. |
|---|---|---|
| Total capital expended ... ... ... | £400,918 | £374,479 |
| Number of units sold— | | |
| Private supply ... ... ... | 4,168,771 | 3,477,833 |
| Public lighting... ... ... ... | 164,438 | 130,097 |
| Traction ... ... ... ... | 3,768,601 | 2,902,546 |
| Total number of units sold ... | 8,101,810 | 6,510,476 |
| Equivalent No. of 8-c.p. lamps connected | 239,366 | 208,306 |
| H.P. of motors connected ... ... ... | 1,776 | 1,346 |
| Number of public lamps ... ... ... | 160 | 156 |
| Maximum load in kw. ... ... ... | 4,889 | 4,558 |
| Revenue account— | | |
| Gross revenue ... ... ... ... | £71,854 | £60,611 |
| „ expenditure ... ... ... | £36,978 | £28,915 |
| „ profit ... ... ... ... | £34,876 | £31,696 |
| Average inclusive price obtained per unit— | | |
| Private lighting ... ... ... | 2·9d. | 3·04d. |
| Public lighting ... ... ... | 2·57d. | 2·70d. |
| Traction ... ... ... ... | 1·25d. | 1·25d. |

### Revenue Account for Year ending March 31st, 1904.

| | |
|---|---|
| Gross revenue ... ... ... ... | £71,854 = 2·14d. per unit. |
| Works and distribution costs (including public lighting) ... ... ... | £25,218 = ·75d. „ |
| Total working costs ... ... ... | £36,978 = 1·09d. „ |

### Profit Statement.

| | |
|---|---|
| Interest on loans ... ... ... ... ... | £11,243 |
| Sinking fund ... ... ... ... ... | 11,091 |
| Balance for year's working ... ... ... | 12,542 |
| Gross profit ... ... | £34,876 |

**Islington Municipal Electricity Supply.**

The latest returns of this Metropolitan Borough are of a somewhat reassuring kind. The financial results of previous years have been somewhat chequered, but this year's surplus of over £1,000 is accompanied by several outstanding features—prominent among them being the considerable reduction in average running and financial costs, and the steady increase in the day load; the latter item alone would account, to some extent, for improvement in the former, although in this case largely assisted by a reduction in the first cost of fuel. Coupled with the recent signs of business-like revival by the department, the year's working must be regarded as a satisfactory sign.

We note that the department still adds a misleading memorandum—in which the total net profit up to date appears as £28,032—although this amount includes £26,818 of sinking fund.

The prices charged are:—Private lighting, 7d. and 2d. maximum demand, or 5d. flat, per unit; daytime, any purpose, 2d. per unit. The chief engineer is Mr. Albert Gay.

### General Statement.

| For year ending March 31st— | 1904. | 1903. |
|---|---|---|
| Total capital expended ... ... ... | £393,172 | £388,670 |
| Number of units sold— | | |
| Private supply ... ... ... ... | 1,794,686 | 1,407,198 |
| Public lighting ... ... ... ... | 1,072,961 | 957,160 |
| Total number of units sold ... | 2,867,647 | 2,364,358 |
| Equivalent No. of 8-c.p. lamps connected... | — | 80,441 |
| Number of public lamps ... ... ... | 483 | 474 |
| Maximum load in kw. ... ... ... | — | 2,100 |
| Revenue account— | | |
| Gross revenue ... ... ... ... | £48,436 | £44,427 |
| „ expenditure ... ... ... | £28,513 | £28,817 |
| „ profit ... ... ... ... | £19,923 | £15,610 |
| Average inclusive price obtained per unit— | | |
| Private lighting ... ... ... ... | 4·4d. | 5·2d. |
| Public lighting ... ... ... ... | 3·5d. | 3·5d. |

### Revenue Account for Year Ending March 31st, 1904.

| | |
|---|---|
| Gross revenue ... ... ... ... | £48,436 = 4·05d. per unit. |
| Works and distribution costs (including public lighting) ... ... ... | £22,858 = 1·91d. „ |
| Total working costs ... ... ... | £28,513 = 2·38d. „ |

### Profit Statement.

| | |
|---|---|
| Interest on loans, &c. ... ... ... ... | £12,525 |
| Sinking fund... ... ... ... ... ... | 6,173 |
| Sundry ... ... ... ... ... ... | 171 |
| Balance carried forward ... ... ... ... | 1,054 |
| Gross profit ... | £19,923 |

## CITY NOTES.

### London United Tramways (1901) Co.

The interim report of the directors announces an interim dividend for the half-year ending June 30th last, at the rate of 6 per cent. per annum upon the ordinary share capital of the company. The traffic receipts for the half-year were £139,452, against £132,932 last year, showing an increase of £6,520 over those of the corresponding period, with an increase in expenses of but £779. During the past seven weeks the receipts were £53,863, an increase of £5,172 over the same period last year. The large additional capital upon which the dividends have to be earned includes heavy expenditure upon important improvements and widenings of roads and streets incident to the doubling of the Hampton Court lines and the construction of the cross-town connecting line between Hammersmith and Uxbridge Road, all of which might probably have been deferred, but the directors have considered it good policy in the permanent interests of the shareholders to at once provide for the future development of traffic rather than delay the outlays which, with the rapid advance in the value of property along the routes, would have had to be made at no distant date at an enormously increased cost. The Act of Parliament promoted by the company this session received the Royal Assent on Monday last week.

### Kalgoorlie Electric Power and Lighting Corporation, Ltd.

This company's meeting, held on Tuesday at Winchester House was presided over by Mr. Roger W. Wallace, K.C., who, in proposing the adoption of the report, said that in that document the directors had gone into the state of affairs of the company as fully as they considered advisable. He had received a letter criticising the date of the meeting. Last year when it was held in October, they received a great many letters from shareholders complaining that it had been deferred, and therefore they determined this year to issue the report at the earliest possible moment. It was not desirable to furnish the shareholders with all the particulars of the business of the company, because they had to carry on negotiations with very important companies in Australia. A great many of the smaller companies in the country had discontinued to work their own mines, the tendency in Australia being to amalgamate the mining interests in a few hands. Therefore, they were pledged to a certain extent not to give full particulars of their output, or the prices of their contracts, or how much power they had left at their disposal, as such information would only be used against them by those with whom they had to negotiate. They stated in the report that shareholders could always obtain information by applying to the secretary at the office, but as there were a good many difficult negotiations going on at the present time, the board had picked out three of the largest shareholders, and given them full information as to what they were doing and how they were going on. Those gentlemen were Mr. Howard, who was the largest shareholder in the company, Mr. Ford, who represented a great many of the shareholders, and Mr. Woolner, the broker of the company. If the shareholders would communicate with those gentlemen, they would be pleased to give them all information. This time last year there was a very much larger amount of calls outstanding than was the case now. In the present balance sheet the unpaid calls stood at £1,948. Since then another £500 had been got in, so that practically they had got rid of what at one time threatened to be an enormous burden on the company. It was satisfactory to know that those calls had been collected practically without any legal expenses. The financial position of the company was very much improved, because, practically, they owed nothing to the bank, as they had more to their credit than the amount they owed. Therefore, it would be seen that the affairs of the company were in a very different state to what they were when they met last year. As the capital was not sufficient they had to raise debentures, and the whole cost of raising that money, including the discounts and brokerage, had been written off. They would see by the report that the power sales for the current year, up to the date of the last return, showed an increase of 95 per cent. over the corresponding period of 1903. They must not, however, expect that rate of increase to go on. It was quite an abnormal increase, because, prior to its taking place, they were supplying much less power

in proportion, than previously, and therefore he did not think that the increase in the remaining portion of the year would be anything near that figure. They had one rather considerable difficulty which, to an extent, was a drawback to them. When they started to equip plant and works for the manufacture of electricity, there was no water in Kalgoorlie that could be used without being treated, as it contained a large quantity of salt. They, therefore, set up an expensive exaporating and condensing plant. Since then the water supply of Kalgoorlie had been completed, and that, of course, enabled a great many of the mine-owners to produce a great deal more electricity with their existing plant, and encouraged them to put up new plant. Under these circumstances the directors found it better to use the city supply of water, but they had their evaporating plant to fall back upon in case of need. With regard to the directors fees in 1903, for 15 months they were £1,700, but they agreed to charge only £1,120. That was for seven directors. Since then the board had been reduced to five, and they had voluntarily limited their fees to £1,000.

Mr. E. Pope, in seconding the resolution, said he could assure the shareholders that everything possible had been done to secure contracts. There was a feeling among many of the shareholders that they ought long ago to have had a full load, and thereby have been making larger profits. He would like to remind such that it was only in October, 1902, that they began to supply mines; consequently, they had only had one full year's work and a portion of another. They could easily have had a full load on long ago, but they would not have made the profits they had if they had done so. The only quarrel they had had in the City with anybody had been from the fact that they would not take contracts that would not pay. He felt sure that in time they would have a full load of paying contracts, and the shareholders would benefit by the waiting policy which the directors were adopting. They had done fairly well since the balance-sheet was made up—much better than if they had been running a full load.

Mr. Woolner said he had come to the meeting intending to voice the very large amount of discontent which existed among the shareholders, who, he considered, had exercised a very great deal of patience in waiting for five whole years without any return on their capital. However, he had no wish to do anything which was likely to create dissension, and they accepted in good faith the offer of the board to let them make a thorough examination into the contracts, and call a subsequent meeting if necessary.

Other shareholders having adversely criticised the report, the Chairman, in reply, said he would not like to prophecy as to when they would be in a position to pay an interim dividend on the preferred shares, especially when they considered the altered state of the mines. They would do their best to earn a dividend, and the result of their negotiations would very much influence the dividend.

The report was then adopted.

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**British Insulated and Helsby Cables, Ltd.** — The directors have declared an interim dividend at the rate of 8 per cent. per annum on the ordinary shares for the half-year ended June 30th last.

**Chatham and District Light Railways Co.**—The directors recommend a dividend on the preference shares at the rate of 5 per cent. per annum, leaving £745 to be carried forward.

**Hadfield's Steel Foundry Co.** — The directors have decided to pay an interim dividend of 1s. per share, being at the rate of 10 per cent. per annum for the half-year ended June 30th.

**Mather & Platt, Ltd.**—The directors have announced that, in addition to the 7 per cent. always paid on the ordinary capital, there will this year be a bonus distribution of 3 per cent. The transfer to reserve is also increased from £36,300 to £50,000, and there is a larger carry forward.

## STOCKS AND SHARES.

Wednesday Evening.

This week it is again Russian tactics which are swaying the markets, and the various "incidents" arising out of the war continue to exert not only a negative restraint, but a positive depression over business in the Stock Exchange. So far as money is concerned, there remains a sufficiency of floating capital that should prove ample for end-of-the-month purposes without affecting the present Bank Rate. Trade in all departments of the House is exceedingly limited, and the end of the present nineteen-day account will be welcomed as affording at least mechanical relief to the idleness of markets in every part. Electrical sections are good throughout, with the exception of that dealing with Railway stocks. Supply shares continue to show improvement, and there is a hardening tone amongst Telegraph issues.

That the steam railway companies should be having electrocution accidents when the electrical railways themselves have been so free from such mishaps, might be counted ironical were the result less tragic. The North-Eastern and the Lancashire and Yorkshire companies have had a number of deaths by the "live" rail, although part of the blame must lie upon the unfortunate victims. The District is taking special care to guard against the peril on its system, and Tuesday's unhappy accidents were due to other causes. Together with other Home Railway descriptions, electric stocks are dullish, and the traffics are not good enough to encourage support. Its decrease of £17 for the week, gives the City and South London a falling-off of £945 since the beginning of the present half-year, and the price of the Ordinary has again receded a point to 40. Waterloo and City at 87½ is also 1 per cent. lower, while Districts are good at 36⅜. A drop of 1 in Metropolitan Railway Consolidated brings the price to 91½. Great Northern and City Preferred have advanced ¼ to 4½.

To praise or to condemn the lately-issued report of the London United Tramways Co., is equally easy. With general trade so indifferent, the company may be congratulated upon earning an additional £6,520 in six months, with an extra expenditure of a mere £799. On the other hand, the increased capital has compelled the directors to declare an interim dividend at the rate of 6 per cent., against the 8 per cent. of a year ago. As the board point out, the increased capital ranking for dividend was raised to pay for work that might have been deferred for some time, but which it was thought desirable to undertake without delay. The price of the Ordinary shares has shrunk a little, to 15½, and some selling orders appeared about three days in advance of the dividend declaration. Not long ago the price was 21½, but as soon as the buying for "control" came to an end, the quotation gradually sagged. The Preference shares at 10½, and the Debenture stock at 104, are unchanged. We remarked this time last year that it seemed a great pity the company should pay at the rate of 8 per cent., when to do so involved dividing the profits so nearly up to the hilt.

Of other tramway issues, City of Buenos Ayres are commanding the most attention, and change hands freely at about 10. Metropolitan Electric Tramway Debenture is a shade firmer at 99, upon the opening of the new section last Saturday. Good buying of Anglo-Argentine Trams keeps the Ordinary and Preference very hard at 6¼ and 5½ respectively. On several occasions we have indicated Auckland Electric Tramways Debenture as a sound 5 per cent. investment, and the price is not likely to stop for long at its current level of 99⅓. Kalgoorlie Electric Power and Lighting Preference at 8s. have not been stimulated by the appearance of the report. Westinghouse Preference seem to have gravelled at 3, and some of the recent buying has a trans-Altantic look. None of the British Electric Traction issues exhibit any alteration.

Rises of 5s. have occurred in County of London Preference at 11⅞, and in Edmundson's Preference at 6⅛. The former is due to the consideration that the shares are cheap compared with those of some of the other lighting companies. Edmundson's have been in demand for several weeks, and the price was advanced in order to tempt shares to market. The 4½ per cent. Preference shares of the Metropolitan Electric have put on ⅛ at 5⅛, and South Metropolitan Electric Ordinary, to give them their new name, are a similar fraction better at ⅞, the Debenture improving to 105. Notting Hill 4 per cent. Debenture is quoted 100 to 103. Beyond a slip-back of 1 in Brush Second Debenture, to 72½, the manufacturing list is practically featureless.

Support is being accorded to Eastern Telegraph, Eastern Extension, and Great Northern Telegraph issues on account of the war. The first-named has risen 2 to 128½, and "Chinas" are ¼ up at 12¼. Our contention that the struggle will do the companies a lot of good in the way of extra traffic is being followed by a few wary buyers, and prices will probably advance further. West Coast of America Debentures are another point harder at 98½.

After rising to 7⅞, Anglo-American Telegraph Deferred has reacted to 7½ middle, and the two other stocks of the company continue unaltered on the week. The American market is still the only department in the Stock Exchange where anything like animation prevails, but the mad gambling in wheat has bred fears lest the strength of Yankee Rails may soon be tapped. When this happens, there will probably be another long period of inactivity for Anglo-American Telegraph stocks to traverse. It may be mentioned that the renewal fund, which a society weekly airily describes as a reserve fund, amounts now to over £980,000, so that the necessity for adding to it will soon be at an end, since a round million is the mark at which the directors aim. After this is secured, the Deferred stands to benefit by augmentation of its profits, which now has to go to the renewal fund. Globe Telegraph Ordinary, at 9¼, have risen the fraction, in sympathy with the strength of the Telegraph market as a whole. National Telephone stocks are quieter, but the Deferred marks a further point rise at 90½, and at 105 the 4 per cent. Debenture stock is also slightly better.

# SHARE LIST OF ELECTRICAL COMPANIES.

## TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1901. | 1902. | 1903. | Closing Quotations Aug. 17th. | Closing Quotations Aug. 24th. | Business done week ended Aug. 24th, 1904. Highest | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 67,100 | African Direct Telegraph, 4 % Debs. | 100 | .. | .. | .. | 97 —101 | 97 —101 | .. | .. |
| 25,000 | Amazon Telegraph Co.'s shares, Nos. 1 to 25,000 | 10 | .. | .. | .. | 2⅛ — 8½ | 2⅛ — 8½ | .. | .. |
| 119,700£ | Do. do. 5 % Debs., Nos. 1 to 1,250 Red. | 100 | .. | .. | .. | .. — .. | .. — .. | .. | .. |
| 788,840 | Anglo-American Telegraph | Stock | 61s. | 60/6 | 61s. | 46 — 49 | 46 — 49 | .. | .. |
| 3,105,680 | Do. do. do. 6 % Pref. | Stock | 6 % | 6 % | 6 % | 90 — 92 | 90 — 92 | 91⅛ | 91 |
| 3,105,680 | Do. do. do. Deferred | Stock | 2s. | 1/- | 2s. | 7 — 7⅛ | 7⅛ — 7⅜ | 7⅜ | 7⅛ |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 | 5 | 5 % | 6 % | 7 % | 5 — 5½ | 5 — 5½ | 5½ | 5⅛ |
| 13,333,300$ | Commercial Cable | $100 | 8 % | 8 % | .. | 170 —190 | 170 —190 | .. | .. |
| 1,841,209 | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | .. | .. | .. | 94 — 96 | 94 — 96 | 95⅜ | 94⅛ |
| 16,000 | Cuba Telegraph | 10 | 4 % | 6½% | 5 % | 7 — 8 | 7 — 8 | .. | .. |
| 6,000 | Do. 10 % Pref. | 10 | .. | .. | .. | 15 — 16 | 15 — 16 | .. | .. |
| 12,981 | Direct Spanish Telegraph | .. | .. | .. | .. | .. — .. | .. — .. | .. | .. |
| 6,000 | Do. do. 10 % Cum. Pref. | 5 | .. | .. | .. | 7 — 8 | 7 — 8 | .. | .. |
| 80,000 | Do. do. 4½ % Debs. | 50 | .. | .. | .. | 98 —101% | 98 —101 % | .. | .. |
| 60,710£ | Direct United States Cable | 320 | 3½% | 3½% | 3 % | 10 — 10⅛ | 10 — 10⅛ | 10⅛ | .. |
| 81,800 | Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red. | 100 | .. | .. | .. | 99 —101 | 99 —101 | .. | .. |
| 4,000,000 | Eastern Telegraph, Ord. Stock | Stock | 7 % | 7 % | 7 % | 124 —129 | 126 —131 | 129 | 127 |
| 1,955,565 | Do. 8½ % Pref. Stock | 100 | .. | .. | .. | 87 — 90 | 86 — 89 | .. | .. |
| 1,584,645 | Do. 4 % Mort. Deb. Stock Red. | Stock | .. | .. | .. | 105 —108 | 105 —108 | 107 | .. |
| 800,000 | Eastern Extension, Australasia, and China Telegraph | 10 | 7 % | 7 % | 7 % | 11⅜ — 12⅛ | 12 — 12⅛ | 12⅛ | 12⅛ |
| 820,000£ | Do. 4 % Deb. Stock | Stock | .. | .. | .. | 103 —106 | 103 —106 | 106 | 104½ |
| 800,000 | Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909 | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 200,000£ | Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000 | 25 | .. | .. | .. | 100 —103 | 100 —103 | .. | .. |
| 180,227 | Globe Telegraph and Trust | 10 | 5½% | £3 16 7* | 5½% | 8⅜ — 9⅛ | 8⅜ — 9⅛ | 8⅝ | 8⅝ |
| 180,042 | Do. do. 6 % Pref. | 10 | .. | .. | .. | 13⅛ — 13⅜ | 13⅛ — 14 | 13⅜ | 13⅜ |
| 150,000 | Great Northern Telegraph, of Copenhagen | 10 | 15 % | 12½% | 15 % | 26½ — 26⅞ | 25⅛ — 26½ | .. | .. |
| 54,700 | Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | .. | .. | .. | 99 —101 | 99 —101 | .. | .. |
| 17,000 | Indo-European Telegraph | 25 | 10 % | 10% | 10 % | 43 — 46 | 43 — 46 | .. | .. |
| 1,988,333 | National Telephone, Pref. Stock | 100 | 5 % | 6 % | 6 % | 104 —106 | 104 —106 | 105⅛ | 104½ |
| 1,966,667 | Do. do. Def. Stock | 100 | .. | 4½% | 5 % | 88 — 91 | 89 — 92 | 90 | 88½ |
| 15,000 | Do. do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | 6 % | 12 — 14 | 12 — 14 | .. | .. |
| 15,000 | Do. do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | 6 % | 11 — 13 | 11 — 13 | .. | .. |
| 2,250,000 | Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 5⅛ — 5⅜ | 5⅛ — 5⅜ | 5⅛ | .. |
| 000,000£ | Do. do. 3½ % Deb. Stock Red. | Stock | 3½% | 3½% | 3½% | 97 — 99 | 97 — 99 | 98⅜ | .. |
| 689,593 | Do. do. 4 % Deb. Stock Red. | 100 | 4 % | 4 % | 4 % | 103 —105 | 104 —106 | 105⅛ | 104⅝ |
| 1,000,000 | Do. do. Prov. Certs., 35 % to be paid | .. | .. | .. | .. | 65 — 67 | 65 — 67 | 66⅛ | 66½ |
| 179,318 | Oriental Telephone and Elec. Nos. 1 to 171,604, fully paid | 1 | 6 % | 6 % | 6½% | ⅞ — 1⅛ | ⅞ — 1⅛ | .. | .. |
| 50,000 | Do. do. do. 6 % Cum. Pref. | 1 | .. | .. | .. | 1 — 1⅛ | 1 — 1⅛ | .. | .. |
| 100,000£ | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 | 100 | .. | .. | .. | 97 —100 | 97 —100 | .. | .. |
| 11,839 | Reuter's | 8 | 5 % | 5 % | .. | 6½ — 7⅛ | 6½ — 7⅛ | .. | .. |
| 3,808 | Submarine Cables Trust | Cert. | .. | .. | .. | 118 —123 | 118 —123 | .. | .. |
| 58,000 | United River Plate Telephone | 5 | 7 % | 7 % | .. | 6 — 6⅛ | 6 — 6⅛ | .. | .. |
| 40,000 | Do. do. 5 % Cum. Pref., Nos. 1 to 40,000 | 5 | .. | .. | .. | 4⅞ — 5⅛ | 4⅞ — 5⅛ | .. | .. |
| 179,947£ | Do. do. 5 % Debs. | Stock | .. | .. | .. | 103 —106 | 103 —106 | .. | .. |
| 15,609 | West African Telegraph, Shares | 10 | .. | 2 % | 4 % | 6 — 7 | 6 — 7 | .. | .. |
| 150,000£ | West Coast of America, 4% Debs., 1 to 1,500 guar. by Brax. Sub. Tel. | 100 | .. | .. | .. | 96 — 99 | 97 — 100 | .. | .. |
| 267,980 | Western Telegraph, Ltd., Nos. 1 to 207,980 | 10 | 7 % | 7 % | 7 % | 12 — 12⅛ | 12 — 12⅛ | 12⅛ | 12 |
| 75,000£ | Do. do. 5 % Debs. 2nd series, 1908 | 100 | .. | .. | .. | 101 —104 | 101 —104 | .. | .. |
| 400,000 | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 99 —102 | 99 —102 | 101⅛ | .. |
| 88,321 | West India and Panama Telegraph | 10 | .. | .. | .. | ⅜ — ½ | ⅜ — ½ | .. | .. |
| 84,568 | Do. do. do. 6 % Cum. 1st Pref. | 10 | .. | .. | .. | 6⅛ — 6¾ | 6⅛ — 6¾ | .. | .. |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. | 10 | .. | .. | .. | 5 — 6 | 5 — 6 | .. | .. |
| 80,000£ | Do. do. do. 5 % Debs., Nos. 1 to 1,800 | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |

## ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 20,000 | British Aluminium 7 % Cum. Pref. | 10 | .. | .. | .. | 5 — 6 | 5 — 6 | .. | .. |
| 800,000£ | Do. do. 5% 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 92 — 97 | 92 — 97 | .. | .. |
| 100,000 | British Electric Traction | 10 | 9 % | 8 % | .. | 8⅜ — 9⅛ | 8⅜ — 9⅛ | 9 | 8⅞ |
| 100,000 | Do. do. 6 % Cum. Pref. | 10 | .. | .. | .. | 10⅛ — 11 xd | 10⅛ — 11 xd | 10⅜ | 10⅜ |
| 600,000£ | Do. do. 5 % Perpetual Debenture Stock | Stock | .. | .. | .. | 116 —119 | 116 —119 | 118½ | 117½ |
| 100,000 | British Insulated and Helsby Cables | 5 | 10 % | 10 % | 8 % | 5⅞ — 6⅛ | 5⅞ — 6⅛ | .. | .. |
| 100,000 | Do. do. 6 % Cum. Pref. | 5 | .. | .. | .. | 5⅞ — 6 | 5⅞ — 6 | .. | .. |
| 50,000 | Do. do. 4½ % 1st Mort. Deb. Red. | 100 | .. | .. | .. | 101 —104 | 101 —104 | .. | .. |
| 50,000 | ¶Brown, Lindley & Co., Ord. | £1 | Nil | .. | .. | ⅝ — ¾ | ⅝ — ¾ | .. | .. |
| 50,000 | ¶ Do. do. 6 % Cum. Pref. | £1 | 6 % | .. | .. | 14/6 to 15/6 | 14/6 to 15/6 | .. | .. |
| 105,731 | Brush Electrical Engineering, Ord., 1 to 105,731 | 2 | Nil | Nil | Nil | ½ — 1 | ½ — 1 | .. | .. |
| 150,000 | Do. do. Non-cum. 6 % Pref. | 2 | 3 % | 6 % | 6 % | 1 — 1⅛ | 1 — 1⅛ | .. | .. |
| 125,000£ | Do. do. 4½ % Perp. Deb. Stock | Stock | .. | .. | .. | 96 — 99 | 96 — 99 | .. | .. |
| 125,000£ | Do. do. 4½ % Perp. 2nd Deb. Stock | Stock | .. | .. | .. | 71 — 76 | 70 — 75 | .. | .. |
| 85,000 | Callender's Cable Construction shares | 5 | 20 % | 15 % | 12½% | 9½ — 10½ | 9½ — 10½ | .. | .. |
| 40,000 | Do. do. do. 5 % Cum. Pref. | 5 | .. | .. | .. | 5 — 5⅛ | 5 — 5⅛ | .. | .. |
| 90,000£ | Do. do. do. 4½ % 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 101 —105 | 101 —105 | 102⅜ | .. |
| 1,860,014 | Central London Railway, Ord. Stock | Stock | 4 % | 4 % | 4 % | 87 — 89 xd | 87 — 99 xd | 87⅞ | 87½ |
| 494,098 | Do. do. 4 % Pref. Stock | Stock | 4 % | 4 % | 4 % | 100 —102 xd | 100 —102 xd | 101½ | .. |
| 494,998 | Do. do. Def. do. | Stock | 4 % | 4 % | 4 % | 80 — 82 | 80 — 82 | 80½ | .. |
| 1,380,000 | City and South London Railway | Stock | 2 % | 3½% | 2⅝% | 40 — 42 xd | 44 — 46 | 41½ | 40½ |
| 85,000 | Crompton & Co., Nos. 1 to 85,000 | 8 | 7½% | 5 % | .. | 1½ — 2 xd | 1½ — 2 xd | 1¾ | .. |
| 100,000£ | Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red. | .. | .. | .. | .. | 94 — 97 | 94 — 97 | .. | .. |
| 99,261 | Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261 | 5 | Nil | Nil | .. | ⅛ — ¼ | ⅛ — ¼ | .. | .. |
| 17,189 | Do. do. "A" shares, 01—017,189 | 5 | Nil | Nil | .. | 1 — 2 | 1 — 2 | .. | .. |
| 44,023£ | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 77 — 82 | 77 — 82 | .. | .. |
| 100,000£ | Do. do. 5% 2n Deb. Stock Prov. Certs. all pd. | 100 | .. | .. | .. | 79 — 83 | 79 — 83 | .. | .. |
| 112,100 | Electric Construction, 1 to 112,100 | 2 | 6 % | 6 % | 4 % | 1 — 1⅛ | 1 — 1⅛ | .. | .. |
| 81,390 | Do. do. 7 % Cum. Pref., 1 to 81,390 | 2 | .. | .. | .. | 2 — 2⅛ | 2 — 2⅛ | .. | .. |
| 82,500£ | Do. do. 4 % Perp. 1st Mort. Deb. Stock | Stock | .. | .. | .. | 96 — 99 | 96 — 99 | .. | .. |
| 25,000 | General Electric Co. (1900), 5 % Cum. Pref. | 10 | 5 % | 5 % | .. | 9 — 9⅛ | 9 — 9⅛ | .. | .. |
| 200,000 | Do. do. 4 % Mort. Deb. | Stock | .. | .. | .. | 93 — 98 | 93 — 98 | .. | .. |
| 200,000 | Henley's (W. T.) Telegraph Works, Ord. | 5 | 20 % | 20 % | 15 % | 11 — 12 | 11 — 12 | 11 | .. |
| 200,000 | Do. do. 4½ % Pref. | 5 | .. | .. | .. | 5 — 5⅛ | 5 — 5⅛ | .. | .. |
| 45,900 | Do. do. 4½ Mort. Deb. Stock | Stock | .. | .. | .. | 107 —111 | 107 —111 | .. | .. |
| 50,000 | India-Rubber, Gutta-Percha & Telegraph Works | 10 | 10 % | 10 % | .. | 18½ — 19½ | 18⅛ — 19½ | .. | .. |
| 800,000£ | Do. do. do. 4 % 1st Mort. Deb. | 100 | .. | .. | .. | 100 —103 | 100 —103 | .. | .. |
| 37,500 | †Liverpool Overhead Railway, Ord. | 10 | 1½% | 1½% | .. | 3½ — 3⅝ | 3½ — 3⅝ | .. | .. |
| 10,000 | † Do. do. Pref. £10 paid | 10 | .. | .. | .. | 9⅜ — 10½ | 9⅜ — 10½ | .. | .. |
| 37,350 | Telegraph Construction and Maintenance. | 12 | 20 % | 20 % | 20 % | 35 — 38 | 35 — 38 | .. | .. |
| 150,000£ | Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909 | 100 | .. | .. | .. | 100 —103 | 101 —104 | 102¾ | .. |
| 540,000£ | Waterloo & City Railway, Ord. Stock | 100 | 3 % | 3½% | 3½% | 87 — 90 xd | 86 — 89 xd | .. | .. |

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st 1904).

## SHARE LIST OF ELECTRICAL COMPANIES (*continued*).— ELECTRICITY SUPPLY COMPANIES.

| Present issue. | NAME. | Stock or Share. | Dividends for the last three years 1901. | 1902. | 1903. | Closing Quotations Aug. 17th. | Closing Quotations Aug. 24th. | Business done week ended Aug. 24th, 1904. Highest. | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 20,000 | Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 .. | £ | 8% | 8 % | 10 % | 10⅞ — 11⅛ xd | 10⅞ — 11⅛ xd | .. | .. |
| 20,000 | Do. do. 7 % Cum. Pref. .. | 5 | .. | .. | .. | 10¼ — 10⅜ xd | 10¼ — 10⅜ xd | .. | .. |
| 250,000 | Central Electric Supply 4 % Guar. Deb. Stock .. .. .. .. | 100 | .. | .. | .. | 106 —109 | 106 —109 | .. | .. |
| 50,000 | Charing Cross and Strand Electricity Supply .. .. .. .. | 5 | 10 % | 10 % | 8 % | 7⅛ — 8 xd | 7⅛ — 8 xd | 7⅞ | 7⅞ |
| 70,000 | Do. do. 4½% Cum. Pref. .. | 5 | .. | .. | .. | 5⅛ — 5⅜ xd | 5⅛ — 5⅜ xd | 5⅜ | .. |
| 40,000 | Do. do. "City Undertaking" 4½% Cum. Pref. .. | 5 | .. | .. | .. | 4⅜ — 5 | 4⅜ — 5 | 4⅜ | .. |
| 40,000 | Do. do. 1903 .. .. .. .. .. | 5 | .. | .. | .. | 4⅜ — 5 | 4⅜ — 5 | .. | .. |
| 250,000 | Do. do. 4 % Deb. Stock Red. .. .. .. .. | 100 | .. | .. | .. | 102 —104 | 102 —104 | 102⅜ | .. |
| 44,436 | *Chelsea Electricity Supply, Ord. .. .. .. .. .. | 5 | 4 % | 4½% | 5½% | 6⅛ — 7 | 6⅛ — 7 | 6⅛ | 6⅛ |
| 150,000‡ | Do. do. % Deb. Stock Red. .. .. .. | Stock | .. | .. | .. | 106 —109 | 106 —109 | .. | .. |
| 70,595 | City of London Electric Lighting, Ord. 40,001—110,695 .. | 10 | 5 % | 5 % | 5 % | 10¼ — 10¾ | 10¼ — 10¾ | 10½ | .. |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 .. .. .. .. | 10 | .. | .. | .. | 13 — 14 | 13 — 14 | 13⅜ | .. |
| 400,000‡ | Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid .. .. | .. | .. | .. | .. | 120 —125 | 120 —125 | .. | .. |
| 800,000 | Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid .. .. | 100 | .. | .. | .. | 102 —105 | 102 —105 | .. | .. |
| 40,000 | County of London Electric Lighting, Ord. 1—40,000 .. .. | 10 | 4 % | 4 % | 4 % | 7⅛ — 8⅛ xd | 7⅛ — 8⅛ xd | 8⅛ | .. |
| 20,000 | Do. do. do. 6 % Pref., 40,001—60,000. . | 10 | .. | .. | .. | 11 — 12 xd | 11 — 12 xd | 11⅞ | 11⅞ |
| 400,000‡ | Do. do. 4½% Deb. Stock .. .. .. .. | .. | .. | .. | .. | 105 —108 | 105 —108 | 107⅛ | 106½ |
| 250,000 | Do. do. 4½% 2nd Deb. Stock .. .. .. .. | Stock | .. | .. | .. | 101 —104 | 101 —104 | 101⅛ | .. |
| 50,000 | Edmundson's Electric Corporation, Ord. Shares .. .. | 5 | 7 % | 7 % | 7 % | 6 — 6¼ | 6 — 6¼ | 6⅛ | .. |
| 80,000 | Do. do. 6 % Cum. Pref. .. .. .. | .. | .. | .. | .. | 6⅜ — 6½ | 6 — 6¼ | .. | .. |
| 140,000 | Do. do. 4½% 1st Mort. Deb. Stock .. | 100 | .. | .. | .. | 104 —107 | 104 —107 | 105½ | 105 |
| 21,000 | Kensington and Knightsbridge Electric Ord. .. .. .. .. | 5 | 10 % | 10 % | 12½ | 12 — 13 | 12 — 13 | .. | .. |
| 90,000 | Do. do. do. 4 % Debenture Stock .. | Stock | .. | .. | .. | 102 —105 | 102 —105 | .. | .. |
| 110,000 | London Electric Supply Corporation, Limited, Ord. .. .. .. | 8 | .. | .. | .. | 1⅛ — 1⅜ | 1⅛ — 1⅜ | .. | .. |
| 49,840 | Do. do. do. 6 % Pref. .. .. .. | 5 | .. | .. | .. | 5 — 5⅛ | 5 — 5⅛ | .. | .. |
| 250,000‡ | Do. do. do. 4 % 1st Mort. Deb. Stock Red | Stock | .. | .. | .. | 96 — 99 | 96 — 99 | .. | .. |
| 100,000 | Metropolitan Electric Supply, 1 to 100,000 .. .. .. .. .. | 10 | 6½% | 7½% | 8½% | 15⅛ — 16⅛ | 15⅛ — 16⅛ xd | 16⅛ | 15⅛ |
| 71,106 | Do. do. 4½% Cum. Pref. 1—71,106, £3 paid .. | 5 | .. | .. | .. | 5⅛ — 5⅜ | 5⅛ — 5⅜ | 5⅛ | 5⅛ |
| 220,000‡ | Do. do. 4½% 1st Mort. Deb. Stock .. .. | .. | .. | .. | .. | 109 —113 | 109 —113 | 111 | .. |
| 250,000‡ | Do. do. 3½% Mort. Deb. Stock Red .. .. | Stock | .. | .. | .. | 96 — 99 | 96 — 99 | .. | .. |
| 10,852 | Notting Hill Electric Lighting .. .. .. .. .. | 10 | 6 % | 6 % | 6 % | 14 — 15 | 14 — 15 | 14⅜ | .. |
| 40,000 | St. James' and Pall Mall Electric Light, Ord. .. .. .. .. | 5 | 14½% | 14½% | 14½% | 14 — 15 | 14 — 15 | .. | .. |
| 20,000 | Do. do. do. 7 % Pref. 20,081 to 40,080 | 5 | .. | .. | .. | 8 — 9 | 8 — 9 | .. | .. |
| 150,000‡ | Do. do. do. 3½% Deb. Stock Red .. | 100 | .. | .. | .. | 97 —100 | 97 —100 | .. | .. |
| 12,000 | Smithfield Markets Electric Supply, Ord. .. .. .. .. | 5 | .. | 2½% | 4 % | 2⅞ — 3⅛ | 2⅞ — 3⅛ | .. | .. |
| 50,000 | Do. do. do. 4 % Deb. Stock .. .. | Stock | .. | .. | .. | 83 — 88 | 83 — 88 | .. | .. |
| 65,000 | South London Electricity Supply, Ord. .. .. .. .. | 5 | .. | 1½% | 3 % | 3⅜ — 4⅛ | 3⅜ — 4⅛ | .. | .. |
| 100,000 | South Metropolitan Electric Light and Power, Ord. .. .. | 1 | .. | .. | .. | 1⅝ — 1¾ | 1⅝ — 1¾ | 1 13/16 | .. |
| 50,000 | Do. 7 % Pref. .. .. .. .. | 1 | .. | .. | .. | 1⅝ — 1⅞ | 1⅝ — 1⅞ | .. | .. |
| 100,000 | Do. 4½% 1st Deb. Stock .. .. .. | 100 | .. | .. | .. | 102 —106 | 103 —107 | .. | .. |
| 80,000 | Urban Electric Supply, Ord. .. .. .. .. .. | 5 | .. | .. | .. | 4⅜ — 5 | 4⅜ — 5 | 4⅜ | .. |
| 80,000 | Do. do. 5 % Cum. Pref. .. .. .. .. | 5 | .. | .. | .. | 4⅞ — 5⅛ | 4⅞ — 5⅛ | .. | .. |
| 110,000 | Westminster Electric Supply, Ord. .. .. .. .. | 5 | 10½% | 12 % | 13½% | 12⅛ — 13⅛ | 12⅝ — 13⅝ | 12⅞ | 12 13/16 |
| 28,141 | Do. do. 5 % Cum. Pref. .. .. .. .. | 5 | .. | .. | .. | 6 — 6¼ | 6 — 6¼ | .. | .. |

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

## MARKET QUOTATIONS, Wednesday, August 24th.

### CHEMICALS, &c.

| | | Latest Price. | Week's Inc. or Dec. |
|---|---|---|---|
| a Acid, Hydrochloric .. .. | per cwt. | 5/- | .. |
| a ,, Nitric .. .. .. | per cwt. | 22/- | .. |
| a ,, Oxalic .. .. .. | per cwt. | 32/- | .. |
| a ,, Sulphuric .. .. .. | per cwt. | 5/6 | .. |
| a Ammoniac, Sal .. .. .. | per cwt. | 42/- | .. |
| a Ammonia, Muriate (crystal) .. | per ton | £33 10 | .. |
| a ,, .. .. .. | per ton | £30 | .. |
| a Bleaching powder .. .. | per ton | £4 10 | .. |
| a Bisulphide of Carbon .. .. | per ton | £15 | .. |
| a Borax .. .. .. .. | per ton | £18 | .. |
| a Benzole (90 %) .. .. .. | per gal. | 7/- | .. |
| a ,, (50/90 %) .. .. .. | per gal. | 5/6 | .. |
| a Copper Sulphate .. .. .. | per ton | £19 | .. |
| a Lead, Nitrate .. .. .. | per ton | £30 | .. |
| a ,, White Sugar .. .. .. | per ton | £31 | .. |
| a ,, Peroxide .. .. .. | per ton | £27 10 | .. |
| a Methylated Spirit .. .. .. | per gal. | 2/6 | .. |
| a Naphtha, Solvent (90% a 160° C). | per gal. | 5/6 | .. |
| a Potash, Bichromate, in casks .. | per lb. | 8d. | .. |
| a ,, Caustic (75/80%) .. .. | per ton | £34 | .. |
| a Shellac .. .. .. .. | per cwt. | 210/- | .. |
| a Sulphate of Magnesia .. .. | per ton | £4 10 | .. |
| a Sulphur, Sublimed Flowers .. | per ton | £6 10 | .. |
| a ,, Recovered .. .. | per ton | £5 10 | .. |
| a ,, Lump .. .. .. | per ton | £5 | .. |
| a Soda, Caustic (white 70 %) .. | per ton | £10 15 | .. |
| a ,, Crystals .. .. .. | per ton | £8 | .. |
| a ,, Bichromate, casks .. .. | per lb. | 2½d. | .. |

### METALS, &c.

| | | | |
|---|---|---|---|
| b Aluminium Ingots, in ton lots .. | per ton | £130 | .. |
| b ,, Wire, in ton lots .. | per ton | £168 | .. |
| b ,, Sheet, in ton lots .. | per ton | £166 | .. |
| b Babbitt's metal ingots .. .. | per ton | £48 to £180 | .. |
| c Brass (rolled metal 2" to 12") basis | per lb. | 6¼d. | .. |
| c ,, Tube (brazed) .. .. | per lb. | 8¼d. | .. |
| c ,, ,, (solid drawn) .. .. | per lb. | 7¼d. | .. |
| c ,, Wire, basis .. .. .. | per lb. | 6¾d. | .. |
| c Copper Tubes (brazed) .. .. | per lb. | 9½d. | .. |
| c ,, ,, (solid drawn) .. | per lb. | 9¼d. | .. |
| c Copper Bars (best selected .. | per ton | £70 | .. |

### METALS, &c. (*continued*).

| | | Latest Price. | Week's Inc. or Dec. |
|---|---|---|---|
| g Copper Sheet .. .. .. | per ton | £70 | .. |
| g ,, Rod .. .. .. | per ton | £70 | .. |
| e ,, (Electrolytic) Bars .. | per ton | £62 | .. |
| e ,, ,, Sheets .. | per ton | £78 | .. |
| e ,, ,, Rod .. | per ton | £72 | .. |
| e ,, ,, H.C. Wire | per lb. | 7¾d. | .. |
| f Ebonite Rod .. .. .. | per lb. | 8/8 | .. |
| f ,, Sheet .. .. .. | per lb. | 8/- | .. |
| n German Silver Wire .. .. | per lb. | 1/6 | .. |
| h Gutta-percha fine .. .. | per lb. | 8/- | .. |
| h India-rubber, Para fine .. .. | per lb. | 5/1 to 5/2½ | inc. |
| i Iron, Charcoal Sheets .. .. | per ton | £18 | .. |
| i ,, Pig (Cleveland warrants) | per ton | 42/11 | 7d. dec. |
| i ,, Forgings, according to size | per ton | From £11 | .. |
| i ,, Scrap, heavy .. .. | per ton | 47/6 to 50/- | .. |
| i ,, Wire, galvanised No. 8 .. | per ton | £9 15 | .. |
| g Lead, English Ingot .. .. | per ton | £12 2 6 | .. |
| g ,, ,, Sheet .. .. | per ton | £11 17s. 6d. | .. |
| m Manganin Wire No. 28 .. .. | per lb. | 8/- | .. |
| g Mercury .. .. .. .. | per bot. | £7 15 | dec. |
| d Mica (in original cases) small .. | per lb. | 6d. to 1/ | .. |
| d ,, ,, ,, medium | per lb. | 2/6 to 4/- | .. |
| d ,, ,, ,, large .. | per lb. | 4/6 to 8/6 | .. |
| p Phosphor Bronze, plain castings | per lb. | 1/- to 1/2½ | .. |
| p ,, rolled bars & rods | per lb. | 1/- to 1/3 | .. |
| p ,, ,, strip & sheet | per lb. | From 1/1 | .. |
| o Platinum .. .. .. .. | per oz. | £4 | .. |
| e Silicium Bronze Wire .. .. | per lb. | 9d. to 11d. | .. |
| i Steel, Magnet, acc'd'g to desc'p'n | per ton | £58 | .. |
| i ,, ,, in bars .. .. | | £15 to £40 | .. |
| g Tin, Block .. .. .. .. | per ton | £124—£125 | inc. |
| g ,, Foil .. .. .. .. | per lb. | 1/6 | ½d. inc. |
| n ,, Wire, Nos. 1 to 16 .. .. | per lb. | 1/7 | .. |
| p White Anti-friction Metals— | | | .. |
| "White Ant" brand .. | per ton | £42 to £62 | .. |
| j Yarns, 2/10s Grey Cotton, on sp'ls | per lb. | 8d. | .. |
| j ,, 6 ics. Flax .. .. .. | per lb. | 5¾d. | .. |
| j ,, 8 ply 10 lbs. Russian .. | per lb. | 4¼d. | .. |
| j ,, 10 lbs. Russian, single .. | per lb. | 4¼d. | .. |
| j ,, 180 lbs. Jute rove .. | per ton | £11 | .. |
| k Zinc, Sh'ts (Vieille Montagne bnd.) | per ton | £25 5 | .. |

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co., *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

## ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

| Locality. | Week ending | Receipts for the week. £ | £* | No. wks. | Total to date. £ | £* | Miles open. | * |
|---|---|---|---|---|---|---|---|---|
| Aberdeen .. .. | Aug. 20 | 1,825 | +292 | 12 | 19,669 | + 3,694 | 10 | — |
| Bath .. .. .. | ,, 17 | 758 | — | 34 | 20,654 | — | 12½ | — |
| Birmingham .. .. | ,, 20 | 5,180 | — 10 | 34 | 182,215 | +11,571 | 8½ | — |
| Blackburn .. .. | ,, 19 | 759 | — 102 | 21 | 20,549 | + 1,860 | 13½ | — |
| Blackpool .. .. | ,, 18 | 2,499 | + 402 | 20 | 25,838 | + 2,740 | 8½ | — |
| ,, —Fleetw'd | ,, 20 | 1,606 | — 350 | 7 | 10,780 | — 551 | 7½ | — |
| ,, —Lytham | ,, 18 | 975 | + 129 | 42 | 14,707 | + 6,277 | 7½ | — |
| Bolton .. .. | ,, 21 | 1,988 | —295 | 21 | 39,708 | — 17 | 25 | — |
| Bournemouth .. | ,, 17 | 1,440 | — 78 | 20 | 28,615 | — | 10½ | — |
| Bradford .. .. | ,, 20 | 4,951 | +829 | 20 | 96,864 | +17,026 | 50 | — |
| Brighton .. .. | ,, 21 | 1,386 | +255 | — | 22,527 | — | 9 | — |
| Bristol .. .. | ,, 19 | 5,029 | +178 | — | — | — | 28 | — |
| Devonport .. | ,, 12 | 613 | +123 | 32 | 17,081 | + 2,771 | 5 | — |
| Dudley—Sto'rb'ge | ,, 14 | 952 | + 12 | 32 | 27,848 | + 1,076 | 18½ | — |
| Gateshead .. | ,, 12 | 918 | + 7 | 32 | 28,965 | + 1,321 | 10½ | + 1/2 |
| Gr'n'k—Pt. Glsgw | ,, 12 | 681 | + 86 | 32 | 18,231 | + 974 | 7½ | — |
| Oldham—Ashton | ,, 12 | 559 | —179 | 32 | 17,486 | — 957 | 8 | — |
| Potteries .. .. | ,, 12 | 1,963 | +620 | 32 | 54,802 | + 4,908 | 28½ | — |
| South Staffs. .. | ,, 12 | 691 | —307 | 32 | 24,873 | — 3,220 | 21½ | — 1/2 |
| Swansea .. .. | ,, 12 | 655 | — 3 | 32 | 17,611 | + 984 | 5½ | — |
| Wolverhampton .. | ,, 12 | 394 | + 12 | 32 | 12,564 | — 104 | 10½ | +8 |
| Yorks. Wool Dist. | ,, 12 | 644 | +120 | 32 | 19,218 | + 7,914 | 6 | — |
| Miscellaneous .. | ,, 12 | 4,945 | — | 32 | 113,917 | — | — | — |
| Burnley .. .. | ,, 20 | 1,128 | +226 | — | — | — | 10½ | +8½ |
| Burton-on-Trent .. | ,, 21 | 375 | — 10 | 20½ | 7,536 | — | 8½ | — |
| Cardiff .. .. | ,, 6 | 2,813 | +216 | 18 | 39,085 | + 1,162 | 14 | — |
| Chatham & District | ,, 18 | 614 | — 29 | 33 | 19,455 | + 2,210 | 9·50 | — |
| Cork .. .. .. | ,, 18 | 541 | —122 | 33 | 15,896 | — 1,928 | 9·89 | — |
| Dover .. .. | ,, 20 | 311 | + 7 | 33 | 7,280 | — 230 | 8 | — |

* Compared with the corresponding period of 1903.

| Locality. | Week ending | Receipts for the week. £ | £* | No. wks. | Total to date. £ | £* | Miles open. * |
|---|---|---|---|---|---|---|---|
| Dublin .. .. | Aug. 19 | 5,377 | + 143 | — | 39,873 | — 3,748 | 47 + ½ |
| East Ham .. .. | ,, 20 | 749 | — 11 | 20 | 15,930 | + 1,958 | 5 + ½ |
| Glasgow .. .. | ,, 20 | 14,111 | + 468 | 13 | 166,762 | +10,911 | 71½ + 6½ |
| Halifax (2 weeks) .. | ,, 10 | 4,046 | + 416 | 19 | 30,397 | + 2,287 | 33 + 1½ |
| Huddersfield .. | ,, 20 | 1,470 | + 150 | 20 | — | — | 28 — |
| Hull .. .. .. | ,, 20 | 2,186 | +253 | 20 | 44,270 | + 5,857 | 13 + 2½ |
| Ilkeston .. .. | ,, 17 | 145 | — 42 | 20 | 3,027 | — | 3·5 — |
| Ipswich .. .. | ,, 20 | 609 | — | 20 | 19,918 | — | 10½ — |
| Isle of Thanet .. | ,, 20 | 2,030 | + 278 | 33 | 23,061 | + 783 | 10½ — |
| Leeds .. .. .. | ,, 20 | 6,033 | + 401 | — | 125,770 | + 7,809 | 81½ + 2 |
| Liverpool .. .. | ,, 13 | 10,907 | + 724 | 33 | 341,017 | +11,806 | 103 — |
| London C. C. .. | ,, 13 | 13,740 | +3906 | 19 | 243,645 | +48,872 | 46½ + 6½ |
| Manchester .. .. | ,, 20 | 12,407 | + 571 | 20 | 251,312 | + 9,573 | 137½ + 12½ |
| Newcastle .. .. | ,, 13 | 3,563 | + 132 | — | — | — | 17 — |
| Portsmouth .. .. | ,, 20 | 2,506 | + 116 | — | 44,480 | + 3,988 | 14½ — |
| Salford .. .. | ,, 15 | 4,021 | + 204 | — | 81,852 | + 6,289 | 30 — |
| Sheffield .. .. | ,, 14 | 4,698 | + 809 | 20 | 95,976 | + 2,354 | 33 + 6½ |
| Southampton .. .. | ,, 11 | 1,145 | —125 | — | — | — | 9 — |
| Southend-on-Sea .. | ,, 17 | 611 | + 53 | 20 | 8,275 | + 992 | 6½ — |
| Sunderland .. .. | ,, 14 | 1,424 | + 19 | 18 | 26,103 | + 664 | 21 + 1 |
| Tyneside .. .. | ,, 17 | 403 | — 32 | 33 | 12,711 | + 2,072 | 8·9 + 1·4 |
| West Ham .. .. | ,, 18 | 1,152 | — | 25 | 21,509 | — | 8·62 — |
| Wolverhampton .. | ,, 17 | 802 | + 354 | — | — | — | 9·5 — |
| Cen. London Rly. .. | ,, 20 | 5,420 | — 25 | 7 | 41,100 | — 2,047 | 6 — |
| City & S. Lon. Rly. | ,, 21 | 2,385 | — 17 | 8 | 18,510 | — 945 | 6½ — |
| Dublin—Lucan Rly. | ,, 19 | 134 | — 30 | 7 | 1,058 | + 29 | 6½ — |
| G. N. and City Ry. | ,, 20 | 991 | — | 27 | 25,304 | — | 3½ — |
| L'pool Overh'd Rly. | ,, 21 | 1,641 | + 75 | 8 | 13,781 | — 163 | 6½ +4½ |
| Mersey Railway .. | ,, 20 | 1,406 | + 88 | 7 | 10,091 | + 585 | 4½ — |

# THE BRITISH ASSOCIATION, CAMBRIDGE, 1904.

## ON LARGE BULB INCANDESCENT ELECTRIC LAMPS AS SECONDARY STANDARDS OF LIGHT.

By J. A. Fleming, M.A., D.Sc., F.R.S., Professor of Electrical Engineering in University College, London.

*(Read before Section G, Monday, August 22nd.)*

The importance of possessing a secondary standard of light which shall be at once portable, convenient, and constant is generally acknowledged; and the choice lies between some form of flame standard and some form of incandescent standard.

For the last eight years the author has employed as a secondary standard of light a type of large bulb carbon filament electric incandescent lamp, which was first devised by him in 1895 in connection with photometric work carried on in the Pender Electrical Laboratory of University College. These lamps were made by the Edison & Swan Electric Light Co., and a large number of them have been issued to the public under the name of the Fleming-Ediswan Photometric Lamp, together with a certificate of the author as to the photometric value. The principle underlying the construction of these lamps is as follows:—It is well known that some types of carbon filament glow lamp, when worked at constant voltage, slightly increase in candle-power for the first 50 hours or so of their life. After that time a stationary period is reached, and then a progressive drop in candle-power takes place. The initial rise in candle-power is due to a gradual consolidation in the filament with use, which reduces its resistance; and the subsequent decay in candle-power is chiefly due to the deposit of carbon upon the bulb. The surface of an ordinary incandescent lamp, 16 c.p., is approximately equal to that of a sphere 3 centimetres in radius, and may be taken roughly as 120 square centimetres. Accordingly, an ordinary small bulb incandescent lamp is not very suitable as a standard lamp. The writer found, however, that by enclosing the filament in a bulb of much greater diameter, say in a cylindrical bulb 12 centimetres in diameter and 20 centimetres in length, giving a total bulb surface of nearly 800 to 1,000 sq. centimetres, the deposit of carbon upon the bulb was greatly diminished, first, because the glass is further removed from the filament, and, therefore, the chances of a carbon molecule getting on to the glass are reduced; and, secondly, because the carbon that is deposited is spread over such a much larger area of glass, that its effect in interfering with the passage of light is greatly diminished. Again, it was found that by subjecting the carbon filament to a certain process of ageing in another bulb, before transferring it to the large bulb, the rise in the resistance of the filament was, so to speak, anticipated.

Accordingly lamps were made to the following specification:—Well selected carbon filaments of the single-loop type of 10 or 16-c.p. were aged and adjusted to an efficiency of 3·5 watts a candle. These filaments were then transferred to large cylindrical bulbs of very clear glass, and finished in the usual manner. See fig. 1.

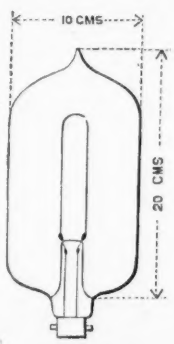



Fig. 1.

Such a large bulb lamp may be called a photometric lamp. A mark is placed on the glass, or on the collar of the lamp, in such a position, so that when the lamp is mounted in the photometer with this mark facing the photometer disk, the axis of the lamp being vertical, and the plane containing the horse-shoe filament is perpendicular to the line joining the lamp with the photometer disk. These lamps are intended to be used in the following manner by a process of photometric "double weighing." Each standard lamp is marked with the voltage at which it will give a certain candle-power in the above-mentioned direction and position. A lamp is then used as follows:—Assuming it to be marked, say, 16-c.p. at 98 volts, the lamp is placed in the photometric gallery, at a distance from the photometer disk of 4 ft., viz.: the sq. root of 16, and by means of a potentiometer and variable resistance, the electric pressure on the terminals of the lamp is adjusted to be 98 volts. Under these circumstances the illumination on the photometer disk is *one candle-foot*. This is balanced by placing on the other side of the photometer disk another incandescent lamp worked at about the same watts per candle, the distance of this last lamp (called the comparison lamp) being adjusted until a photometric balance is obtained.

The standard lamp is then removed from the photometer, and its place is taken by any lamp, the candle-power of which it is desired to ascertain at a certain voltage. The voltage having been adjusted, this last lamp is then moved to or from the photometer disk until it photometrically balances the comparison lamp. Let us imagine that it balances the comparison lamp at a distance of 50 in. The candle-power of this last lamp is then equal to 17·36 candles, being to the standard lamp in the ratio of the square of 50 to the square of 48.

Such an operation has been called by the author a photometric double weighing, because it resembles the process by which the exact weight of an object can be ascertained by means of good weights with an imperfect balance.

By following the above method, no want of symmetry in the photometer vitiates the process of measurement; neither are we concerned with the exact value of the comparison lamp, as long as it remains constant during the experiment. All that we are concerned with is the exact value of the standard lamp used for setting the comparison lamp, and with the ratio of the distance of the standard lamp from the photometer disk to that of the measured lamp. Hence, if the distances are correctly measured, we have the exact ratio between the candle-power of the standard lamp and that of the lamp being measured.

It has been found by large experience that this process is more accurate than the usual plan of placing the photometer between the two lamps, and moving the photometer to and fro until the balance is obtained. In this last method we are liable to error in consequence of any want of symmetry in the photometer itself, and also by reason of the fact that the continual moving of the photometer varies the value of the absolute illumination on the photometer disk. It has been found that, even when using the best Lummer Brodhun photometers, there is a certain asymmetry in the instrument or the disk. If a photometric balance is obtained between two lamps, one on each side of the photometer, then, on reversing the disk, the balance is no longer obtained, but the photometer has to be moved to a further position. This difference is not apparent when the photometer is simply turned over, prisms and disks moving together, but differences amounting to 5 per cent. in the value of the readings of the candle-power of a lamp have been found in some instances when the disk alone is reversed.

These large bulb lamps are not intended to be used as working standards and kept incandescent for any length of time, but merely as secondary standards for a few minutes to adjust the distance of the comparison lamp, and from the photometer disk. In this manner one may be used many thousands of times without being in a state of illumination altogether for more than a few hours. By employing a number of these lamps and checking them one against the other, and never allowing the voltage on the lamp to exceed the marked volts, a means is provided of determining and preserving a standard of light with very considerable accuracy.

In connection with the construction of these large bulb lamps, the following points are important:—

The filament should preferably be in the form of a single loop or horse-shoe, and should be mounted in the large cylindrical bulb with great care, so that the plane of the loop lies in the axial line of the lamp, filaments being selected with the two sides of the loop in the same plane and not distorted.

In some cases, it is desirable to anchor the filament by a loose loop of platinum wire, sealed into the bulb, but such loop of wire should not touch the filament or constrain it when the lamp is at rest or in use.

Owing to the fact that the 16-c.p. 100-volt filament is about 9 in. in length, it is desirable, if possible, to employ a 10-c.p. 60-volt large bulb photometric lamp as a standard. The 16-c.p. 100-volt lamp of this type is much used, and the 16-c.p. 200-volt lamp has been made, but is not recommended.

It is not desirable to employ two filaments in parallel, as they may then be at different temperatures, but they can be placed in series, one loop within the other, and both lying in the same plane.

In setting the lamp in the photometer, great care must be exercised to adjust the lamp axis perfectly vertical, and a plumb line should be employed to mark the position of the mean line of the filament as read on the scale of the photometer bench.

In the use of these lamps, the following precautions should be taken:—(1) The lamp should never be raised above the voltage marked upon it by the manufacturer; (2) in the next place, great care should be taken that good contact is made between the socket and the sole-plate on the lamp; it is better, therefore, to solder a pair of wires to each sole-plate of the lamp collar, one pair being employed as the leads for the current to the lamp, and the other pair as potentiometer or voltmeter wires to ascertain the exact potential difference between the sole-plates of the lamp. This adjustment of potential is best effected by means of a variable rheostat and a potentiometer. In the certificate issued with each of the Fleming-Ediswan photometric lamps, a statement is made of the exact voltage and current at which the lamp gives a certain candle-power at a certain temperature. If used with the above precautions, experience accumulated during the past eight years has shown that these lamps are capable of preserving an exceedingly constant candle-power, and that, as standards of light, they are more portable, and require none of the corrections necessary in the case of flame standards.

The great objection which may be urged against the use of all flame standards, is the degree to which their candle-power is affected by moisture in the air and changes in barometric pressure. It has been shown by researches made at the Reichsanstalt on the Hefner lamp, that the light emitted decreases about 0·5 per cent. with every additional litre of water vapour present in the atmosphere, above a certain normal value. Taking the average varia-

tions of moisture in the air from month to month, we find that this implies a variation of about 4 per cent. in the light emitted in the Hefner lamp between the wet and dry seasons of the year; this variation greatly exceeds the limits of possible error in photometric observations. With very little care, photometric comparisons can be made within 1 per cent., hence, comparisons with a flame standard are not sufficiently definite unless the value of the flame standard has been corrected for moisture and barometric pressure. The authorities of the Berlin Reichsanstalt take the standard state of the atmosphere with regard to moisture to be that in which it contains 8·8 litres of water vapour per cubic metre of dry air. The atmosphere of Berlin, however, is distinctly drier than that of London, and the author has been informed by Dr. Glazebrook, F.R.S., Director of the National Physical Laboratory of England, that he considers for Great Britain it will be better to take as a standard state 10 litres of water vapour per cubic metre of dry air, as more nearly representing the average state of the British atmosphere.

Dr. Glazebrook has made a prolonged study of the Harcourt Pentane 10-candle lamp, in regard to variation of candle-power of the latter with atmospheric moisture and pressure, the results of which he will, no doubt, make known in due time; meanwhile, he has privately communicated to the writer information which shows that the correction of the candle-power in the Pentane lamp, due to moisture in the air, or rather, deviations from the standard state of moisture, is at least as great as that of the Hefner lamp. There seems reason to believe that this correction would be about the same for all flame standards.

Dr. Glazebrook has been so kind as to communicate to the writer a formula for the correction of the Pentane lamp for variation in illuminating power, due to atmospheric moisture and pressure which he has obtained, but it must be considered as merely privately and unofficially furnished, and therefore subject to any future correction by him.*

Taking the Harcourt 10-candle Pentane lamp to emit a light of 10 c.p. when the barometric pressure is 760 mm. and the atmospheric moisture 10 litres per cubic-metre, then the candle-power (*c p*) corresponding to a barometric pressure of *b* millimetres, and a hygrometric state of *e* litres of water vapour per cubic metre, he finds that *c.p.* can be expressed as follows:—

$$\text{Candle-power of the Harcourt Pentane lamp} = 10 + 0{\cdot}066\,(10 - e) - 0{\cdot}008\,(760 - b).$$

The water vapour present may often reach to 15 to 16 litres per cubic metre. This variation alone will decrease the candle-power by 3 per cent., or rather more. Hence, if the correction is not applied, and the Pentane lamp then is used directly to standardise an incandescent lamp, and assumed to be 10-c.p., the candle-power of the electric lamp may be marked as much as 3 per cent. too high. In other words, an error of nearly 0·5 candle may be made in marking a 16-c.p. lamp.

This source of error only presents itself in comparing a flame standard with an incandescent lamp. When two flame standards such as coal gas and Pentane are being compared, the atmospheric moisture affects both flames about equally.

The writer has recently had careful tests made to ascertain if these large bulb incandescent lamps gave the same candle-power at the same voltage and current, irrespective of variations in the temperature of the surrounding atmosphere.

With this object, an experiment was made by Mr. G. B. Dyke in the photometric gallery of the Pender Electric Laboratory, at the suggestion of the author. A large iron box was provided having an oval hole in front, about the size of one of the large bulb lamps. A lamp of this description was mounted on a socket and suspended in this box with its axis vertical. At the bottom of the box were placed some coils of iron wire which could be heated by an electric current. In this manner the temperature of the air in the box was gradually raised and the lamp was surrounded by an atmosphere of warm air. The temperature of this air was taken by four thermometers placed in the box. The readings of these thermometers were taken together with the candle-power of the lamp, and the values found to be as follows:—

| Atmospheric temperature in Centigrade degrees. (i) | (ii) | (iii) | (iv) | mean. | Candle-power of large bulb lamp. |
|---|---|---|---|---|---|
| 23°·6 | 24°·4 | 22°·8 | 22°·8 | 23°·4 | 13·84 |
| 27°·4 | 27°·7 | 28°·0 | 26°·4 | 27°·4 | 13·81 |
| 42°·0 | 44°·4 | 46°·9 | 37°·5 | 42°·4 | 13·81 |
| 67°·2 | 69°·4 | 77°·2 | 53°·3 | 66°·8 | 13·77 |

Hence it is clear that there is practically no change in the candle-power of the lamp with change of temperature of the surrounding atmosphere.

These lamps therefore present the following valuable features when employed as secondary standards of light:—

(1). The candle-power does not vary with the atmospheric moisture, barometric pressure, or atmospheric temperature.

(2.) If the lamp is properly prepared and used as described, the candle-power given by it depends on nothing but the current passing through the filament, and this last can be measured to within 0·1 per cent. or less by means of a potentiometer, and the candle-power therefore known to within 1 per cent.

The experience so far gained shows that if a number, say 6, of these standard photometric lamps are kept and compared with one another at intervals, the observer has always the means at his disposal of determining the candle-power of an incandescent lamp within 1 per cent.

(3.) Great portability as a standard.

The lamp is very portable and there is no difficulty in sending these lamps suitably packed to the other side of the world. Anyone with secondary cells as a source of current and a potentiometer as a measuring instrument, has the means of setting up a standard of light as least as accurate and constant as a good flame standard.

These lamps, in fact, afford the best means of determining the the variation of flame standards with barometric pressure and atmospheric moisture, and photometric comparisons between a large bulb lamp, as devised by the writer, and a flame standard is, in fact, a checking of the latter by the former, and not the reverse.

In equipping an electrical laboratory with the means of preserving a standard of light, the author recommends the following procedure as the result of eight years' experience of it:—A stock, say, of 12 of the large bulb photometric lamps is provided. Those of the writer's pattern issued by the Edison & Swan United Electric Light Co. are each sent out in a stout millboard box.

These lamps should all have their candle-power carefully determined at a marked voltage so chosen that the efficiency is about 4 watts per candle. The current at this voltage should be measured. This candle-power current and voltage should be marked on the box. If this calibration is made against a flame standard, then the greatest care should be taken to correct the value of the flame standard for atmospheric moisture and pressure.

The candle-power ratios of these lamps should be taken, and six of them should be preserved as ultimate standards of reference for the adjustment of the other six. These last may be used for setting the comparison lamp in the photometer, and they should be compared at intervals with the first six lamps which are reserved as prime standards of reference. If the six working lamps are used, turn-and-turn about and inter-compared with the reference standards, they may be used thousands of times without being actually burning for more than a few hours, and the tradition as to the unit of light or illumination can be transmitted without risk of change.

As an instance of the utility of these lamps in the comparison of flame standards, it may be mentioned that the author recently sent three of these large bulb standard lamps to Berlin by his assistant, Mr. W. C. Clinton, and they were photometrically measured in the Physikalisch Technische Reichsanstalt at Charlottenburg. The same lamps were subsequently taken to the National Physical Laboratory, Bushy House, Teddington, and measured independently. In Berlin the standard of comparison was a Hefner lamp, and at Bushy House it was a Harcourt 10-c.p. Pentane lamp. The ratios of the certified readings gives us the value of the Hefner unit in mean British candles, and it is close to the value usually assumed.

These three lamps are called Pender IV., Pender VI., and Pender X. respectively. The results are tabulated below:—

| Lamp mark. | Value of the illuminating power in Hefner units assigned at the Reichsanstalt. H.U. | Value of the illuminating power in British candles assigned at the Nat. Phys. Lab. C.P. | Value of the Hefner unit in British candles. |
|---|---|---|---|
| Pender IV. | 15·1 | 13·41 | 0·888 |
| Pender VI. | 12·6 | 11·12 | 0·883 |
| Pender X. | 15·9 | 14·07 | 0·885 |

The mean value of the ratio is 0·885.

The lamps were all measured at 96 volts, and the current values obtained at the Reichsanstalt agreed with those obtained at Bushy House within 1 part in 1,000.

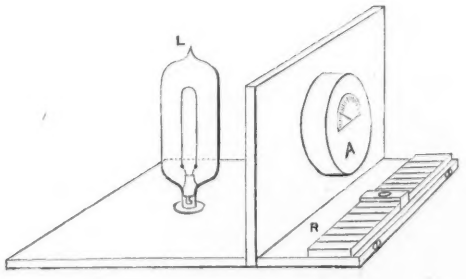



Fig. 2.

Hence we may take it that the above fraction 0·885 represents very nearly the ratio between the Hefner unit as employed at Berlin, and the mean British candle as employed in London as a standard of illumination.

In connection with these large bulb lamps, the author has arranged a simple apparatus consisting of a large bulb lamp, a rheostat and an ammeter, the range of which comprises merely the ordinary lamp currents. The ammeter is, however, not graduated

* An account of these researches was given in a Paper read before Section G of the British Association by Mr. C. C. Paterson, who conducted the experiments at the National Physical Laboratory on this subject (see p. 355).

to read amperes, but graduated to read candle-power, so that if the rheostat is adjusted to make the ammeter needle point to any part of the scale, that scale reading would at once, without further calculation, give the candle-power of the lamp in the normal direction. Although this apparatus is not accurate enough for laboratory purposes, yet for workshop or generating station purposes it is a convenient arrangement for obtaining a fairly accurate standard of light without the complications involved with the use of the potentiometer. The arrangement of the apparatus is shown in fig. 2.

In conclusion, the author has to record his thanks to Mr. W. C. Clinton, B.Sc., for much laborious and careful work during many years in making numerous photometric comparisons, but the experience so gained has every year tended to confirm the opinion that these large bulb incandescents, when used as described, form a most convenient and constant standard of light.

## SOME INVESTIGATIONS ON THE TEN-CANDLE POWER HARCOURT PENTANE LAMP, MADE AT THE NATIONAL PHYSICAL LABORATORY.

By Clifford C. Paterson.

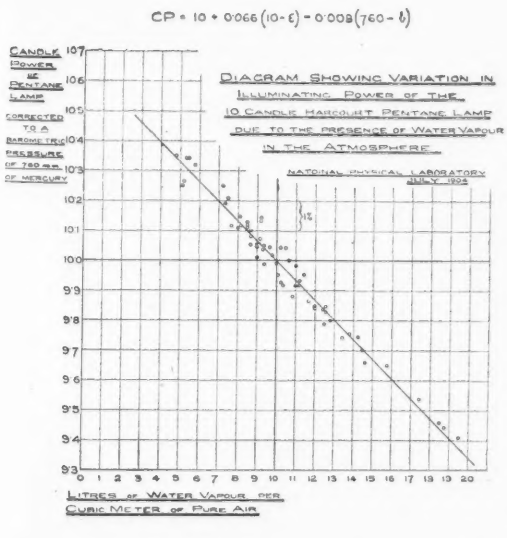
*(Read in Section G, August 22nd.)*

The 10-c.p. Pentane lamp, designed by Mr. Harcourt, is now generally accepted in this country as the standard of illuminating power, and has been adopted, with slight alterations, by the principal gas companies in the United States. In this paper it is proposed to give briefly the results of investigations carried out at the National Physical Laboratory in order to determine the change in the candle-power of the lamp due to variation

1. In barometric pressure,
2. In the quantity of water vapour present in the air.

It has been generally admitted that changes occur in the illuminating power due to these causes, but that in the case of comparisons between the Pentane standard and gas lights, the latter will probably be affected to the same extent as the standard lamp, rendering any correction unnecessary. This is by no means the case when photometric comparisons are made between the Pentane standard and a source of light unaffected by atmospheric conditions, as, for instance, an electric glow lamp, and errors of the order of 5 per cent. may be introduced into candle-power measurements if corrections are not made for the hygrometric and barometric conditions existing at the time.

In order to ascertain the amount of variation, photometric comparisons were made against two large-bulb Fleming-Ediswan electric standard glow lamps. The double comparison method only was employed, and the two electric lamps used to standardise a


CP = 10 + 0·066 (10 - ε) - 0·008 (760 - b)
Candle Power of Pentane Lamp corrected to a Barometric Pressure of 760 m.m. of Mercury
Diagram Showing Variation in Illuminating Power of the 10 Candle Harcourt Pentane Lamp due to the Presence of Water Vapour in the Atmosphere.
National Physical Laboratory July 1904
Litres of Water Vapour per Cubic Meter of Pure Air

comparison glow lamp anew for each experiment, so that it was only necessary to burn the standards for five or ten minutes at a time.

It is found convenient to state humidity volumetrically as the number of litres of water vapour to a cubic metre of pure dry air, at the barometric pressure existing at the time; so that if

$b$ = reading of barometer in mm.,

$e$ = aqueous pressure, and

$e_1$ = vapour tension of carbon dioxide present in the atmosphere, the litres of water vapour per cubic metre of pure air—

$$\epsilon = \frac{e}{b - e - e_1} \times 1{,}000.$$

Upwards of 60 observations have been made on different days over a range of humidity, varying from 5 to 20 litres per cubic metre, which are about the limits obtained under ordinary conditions in a well ventilated photometer room; 80 per cent. of these when corrected by means of the formula, fall within + or − one-half per cent. of 10 c.p.

The barometric pressure in these observations has varied from 739 to 780 mm. of mercury, so that, applying the method of least squares for these two variables, the following formula has been obtained for correcting the candle-power of the lamp to the standard atmospheric conditions of 760 mm. of mercury and 10 litres of water vapour per cubic metre of pure dry air.

Candle-power = $10 + 0{\cdot}066\,(10 - \epsilon) - 0{\cdot}008\,(760 - b)$, where $\epsilon$ is the humidity, as explained above, and $b$ the height of the barometer in mm.

From this it will be seen that a variation of one litre per cubic metre in the moisture, causes a variation in candle-power of about 0·7 per cent., and that 10 mm. change in barometric pressure brings about an alteration of 0·8 per cent. in the illuminating power of the lamp.

The standard humidity of 10 litres per 1,000 has been fixed upon as being the mean value for three years found at Kew Observatory. The figure is also borne out by observations made at the meteorological office in Victoria Street, London.

## INSTITUTION OF ELECTRICAL ENGINEERS.

### MOTOR-STARTING SWITCHES AND RESISTANCES.

By F. O. Hunt, Associate Member.

### Discussion.

*(Concluded from page 289.)*

Mr. Bate said it seemed to him, as a user, that more troubles occurred in the ordinary switchwork and in connection with switch construction than arose either from the motor or the starter, through improperly proportioned resistance. Provided wires of sufficient capacity were used, he had not noticed that much trouble was occasioned to the user by rushes of current, and certainly not any serious trouble by sparking while the motor was being stopped. He did not quite follow Mr. Hunt where he supposed a case in which there was 3 sec. pause on each stud. If he only made his wires equal to that duty, it was obvious from the curve in fig. 2 that they would very soon be burnt out. But supposing they took a rating of 30 sec. on each stud, *i.e.*, 30 sec. on the whole of the resistance—it would not come to more than 50 sec. on the average on the last stud, and there the curve had got flat. Mr. Hunt did not tell them what relation the safety factor curve bore to the experimental curve, but it seemed about half or a little less than half of the watt value. He thought the saving of the starter lay, from the user's point of view, in strengthening the switch parts, and if sparking had to be guarded against, in using a carbon auxiliary contact instead of the copper brush.

Mr. Gott said he could fully endorse Mr. Hunt's remarks regarding the starter injuriously affecting the commutator. The want of uniformity in specifications was another difficulty to which he could testify. The greatest fault at the present time seemed to be that the armature resistance was assumed at an altogether erroneous figure, so that the starters burnt very badly on the final contacts. With regard to sparking, his own practice for four or five years had been to sub-divide starters in this way. The total resistance was divided into three parts. The first part, starting at armature, was divided into geometrical sections, and was carried up to a point at which the resistance contained within the section contained the maximum difference of potential allowed. The second part contained equal sections, and was taken up to the point at which the maximum current only would flow with stationary armature, and from that point to the end. The third section consisted of a geometrical division with a new factor, that factor being found by the ratio of the last equal section to the total resistance then in circuit. The resistance plotted out to scale followed a curve with "geometrical" ends merging into a straight line centre. The values of total resistance to any section were easily found by the usual slide rule methods, but the actual factor of increment and sparking d.p. allowable was very largely a matter of compromise to suit the total number of section connections in the switch, owing to the cost being a limiting factor to the number adopted. His own practice had been to work in a current of 100 amperes, with a d.p. of 30 to 35 volts, but he had used as low a value as 25 volts with 100 to 200 amperes, and about 60 res. sections to satisfy rigid specifications. The cost of manufacturing starters with so many contacts was a limiting factor, and the values of d.p. increment to be employed were controlled by the factors enumerated, and also by the requirements of the driven machinery. He was rather surprised to find that Mr. Hunt advocated the use of inductive resistance. The cure was worse than the disease. Although it would certainly lower the peaks, Mr. Hunt seemed to have forgotten that regulators were frequently used in which it was necessary to slowly insert resistance, and that would cause most excessive sparking. There were at least two other methods in addition to those mentioned by which sparking might be reduced, and the number of contacts kept as few as

possible. One was to carry an electro-magnetic blow-out on the arm, and the other to use a vernier resistance. He was not aware that either of those methods had been successfully carried out, but he offered the suggestion for what it was worth. As to the second part of the paper, Mr. Hunt had gone a long way round to demonstrate his points. In a monograph signed "T. C.," or "T. Carter," published in the *Electrical Engineer* about 1897, it was shown that only one experiment was necessary for all the materials and gauges, with one limit of temperature.

Dr. W. E. Sumpner said that the law of regulating the different steps of the resistance depended on the assumption that there was a fixed current corresponding to turning the motor round. The steps would depend upon the starting current, and the starting resistance would thus have to be designed for the particular load against which the motor started. With regard to the specification for a starting resistance quoted by Mr. Hunt, it did not specify what was the current which the motor took to turn it round, and the whole construction of the resistance must depend on that current as well as on the other things. If the specification of what a starter was supposed to do was so vague as that, there was no wonder that the points of such specifications had been ignored by contractors. He should like to raise the question whether anyone did measure the current rush in a motor starter. He did not think it could be measured, except by an oscillograph. With regard to Mr. Hunt's allusion to sparking voltage, he should like him to specify exactly what he meant when he said: "This quantity is evidently the drop of volts which takes place over the section of resistance between the two studs concerned when the resistance carries the current normal to it before the short circuit takes place." It seems to him that the C.R. drop of volts was only the minimum value of the sparking voltage. The most important source of the sparking voltage was the self-induction effect owing to the sudden change of current, either when they short-circuited or open-circuited a section of the resistances, and that made him rather doubt the suggestion of making up the resistance winding in an inductive form.

Mr. R. A. Chattock said the central station engineer was interested most in the way his voltage was affected by the rushes of current experienced in starting-up motors. He had never found that the life of the motors suffered from faulty design or construction of the starters. The ordinary motor of to-day was built sufficiently strong to stand any rush of current that might be put upon it by a badly-designed starter. But the motor starters themselves were affected in several ways. The contacts became burnt owing to sparking, and he did not quite see how that was to be prevented with the ordinary commercial type of motor starter. One very great fault in them was that the wires became burnt out. He had found that to be due chiefly to the nature of the wire that was used. In most commercial starters iron wire was used, in many cases of a very small diameter, and after being in use for a year or two, the wires became oxidised and very soon burnt through. He had always specified German silver or other wire that was not effected by oxidisation, and he had never had any real trouble with starters built in that way. The burning of the contacts, he thought, was best got over by making them large enough, and where any special contact was subject to excessive sparking, by fitting a carbon break to it. He did not believe in a starter which was operated by a spring. He found that if contacts became burnt, the spring was not, as a rule, strong enough to carry the arm over them, and the starter often remained half on when it should be full on. He thought a starter operated by a handle on the arm itself was the best. A specification for a motor starter should, in his opinion, include the maximum current per stop. That could be got satisfactorily, and by specifying that, they could protect the voltage on the supply mains from being affected in any way. He had found in practice that 10 amperes per stud for a 440-volt supply was ample to protect the lights of the other consumers on the main from being affected. For a 220-volt supply on each side of the network he should not like to allow quite so much, as the resistance of the neutral wire came in when the balance on the two sides was affected, but protection for this effect was got by using only small motors on the lower voltage.

Dr. T. Torda Heyman said, referring to the author's remark that no maker had yet adopted a device where the inductive effect of the resistance winding was utilised, he might mention a case of a three-phase motor-starter, to illustrate what it meant to introduce an inductive effect into the starter. In this starting switch the flat strip resistance coils were wound on an iron core insulated with asbestos, and each coil was covered with a projecting iron ring, which was ribbed to assist the cooling. The inductive effect of the resistance coils appeared in considerable value, causing more trouble than advantage. It was, therefore, found preferable to wind each successive coil in the reverse direction to get over these effects and trouble. Mr. Hunt proposed to take the rating of starting resistances on experiments connecting the current and time to produce the "just visible red," with a safety factor which must be chosen to suit the different conditions of ventilation, &c. It would be of interest to fix the value of these safety factors, and he suggested that it could be done by specifying the maximum permissible temperature for the material (say German silver) as follows:—

| | | | |
|---|---|---|---|
| For switches for starting only | ... | ... | 300° C. |
| " " on intermittent work | ... | ... | 250° C. |
| " speed regulators placed separately | | ... | 200° C. |
| " " " placed on switches | | ... | 100° C. |

To arrive at the proper definition of these safety factors, first of all he would draw attention to the fact that the curve in fig. 2 could be conveniently expressed by the formula,

$$\frac{1}{C} = \frac{t}{K_1 + K_2 t},$$

where C = current in amperes, $t$ = time in seconds, and $K_1$, $K_2$ are constants. Their values for Mr. Hunt's experimental starter were 80 and 5 respectively. Applying this formula to his own experimental data, he found somewhat different constants, which were caused by differences in the arrangement of resistances, &c. The formula was similar to that of the saturation curve, and was entirely empirical, although it could be regarded as a simplified derivative of the theoretical logarithmic expression. These constants were, for all sizes of wires, applicable in the manner suggested by Mr. Hunt. He also pointed out that these experimental figures might be advantageously combined with Kennelly's formula—

$$C = K\sqrt{\frac{T d^3}{\rho}},$$

which gives the final temperature rise of a round wire carrying a current C. K = constant, T = temperature rise in Centigrade, $d$ = diameter of wire in mm., $\rho$ = specific resistance of the material. For Mr. Hunt's experimental starter he found K = 0·16, but the type of starter with which he experimented gave a constant of 0·25. With the combination of the two equations referred to, it was possible to fix such safety factors as defined by Mr. Hunt. For obtaining information of practical value in the design of a line of starters, the experiment of observing the "just visible red" temperature would, he thought, prove to be the simplest method available.

Mr. Forster thought the considerations Mr. Hunt had put before them had a very distinct relation to the mechanical details, with which he did not deal at all. Was it not a fact that they could do with greater flashing voltage between the contacts, if the contacts were designed with more weight of material and disposed in such a way as to admit of a certain amount more heat being dissipated? It seemed to him that sub-division of the sliding contacts, especially in motors of from 100 to 150 amperes and upwards, made a very great difference. The idea of the solid block for sliding contact was frequently carried too far. By dividing the sliding contact, so as to get in large starters eight or ten fingers or laminations making contact simultaneously on the block, the quality of the contact surfaces was greatly improved and the sparking due to mechanical causes was reduced. In the case of the larger motors, he thought it was not good or conservative practice to design a motor starter resistance so that it would take full load current on the first step. If designed so that it took distinctly less, the motor would not start under full torque at the first or perhaps the second step, but when they came to the third the motor would start and the pitting of the contacts would be very much reduced. He would like to know if the rounding on the first peak of the curve which Mr. Hunt had shown was really due to self-induction, or to the starting characteristics of the motor. He had tried the electro-magnetic blow-out on starters, and thought the simple method of keeping plenty of weight and good design in the contact-making parts the better. One objection he found to the electro-magnetic blow-out as fitted to starters (not drum type controllers) was the waste of the auxiliary contact where the spark was suppressed.

Mr. Hunt, in reply, refused to admit Mr. Burnand's contention that the inductive resistance was an impossibility so long as it was assumed to be of the absorption type. As to the objection of Mr. Dix to the direction followed in the progression, it was begun from the point which the contact brush first reached in starting up the motor, as this tended to make it more understandable to the people who were actually making the thing and doing the testing. The object of the reference to specifications was to point out the general lines which should be followed, and to show that nothing at present made really fitted in with requirements frequently laid down, and, that, therefore, the demands made must be in excess of actual requirements. As to limiting the current rushes, did Mr. Dix mean that working was satisfactory when the increments were double the steady value, or that the current was doubled?

Mr. Dix: The actual value, not the increase above.

Mr. Hunt said he was referring in his paper to the increment. He agreed that probably the sparking trouble was largely a mechanical matter, and that it was to some extent a question of weight of metal in the studs. In reply to Mr. Bates, he thought he would be justified in saying that very often the mechanical troubles had an electrical origin in the resistances connected with the studs. Mr. Bates's allowance of 30 seconds per stud must surely make the starter a good deal more expensive than anything anybody puts on the market nowadays. It was obvious from the curve (fig. 2) that at about the third stud one would have practically regulating resistances, for at 60 secs. one had approached very near the limiting value. Carbon auxiliary contacts were employed in the starter lent by Messrs. Bray, Markham & Reiss, for the oscillograph experiments on current peaks during starting. With regard to inductive winding of the resistances, the idea was, of course, only applicable, as stated in the paper, to those cases where there was a non-return action on the switch. He would like to know whether the first law mentioned by Dr. Heyman was arrived at empirically or from first principles.

Dr. Heyman said it was entirely empirical.

Referring to Dr. Sumpner's criticisms as to the use of the symbol C for a certain definite quantity, he said he simply took the worst cases that could arise with fair treatment of the motor. Taking exception to what he had termed the "current increment," Dr. Sumpner said it was not the instantaneous rush of current. He (Mr. Hunt) did not know what else it was. That to which he gave the symbol $C_1$ was intended for the instantaneous increment, supposing no self-induction in the circuit. He wished all station engineers would take note of Mr. Chattock's recommendation of 10 amperes per stud as a satisfactory limit on 440 volts, and would forthwith abandon the "5 ampere" specification. The vernier resistance idea mentioned by Mr. Gott had been put into execution some time

ago by a French firm. Referring to Mr. Forster's question whether the rounding or levelling of the top of the curve was really due to self-induction, or whether it was the result of the starting characteristic of the motor, he might say the results were obtained on a motor running light. The load was simply that due to the fly-wheel effect of the armature and pulley, this being chosen because its effects are the most suitable for record by the oscillograph.

Mr. J. K. Catterson-Smith, Student (Communicated):—Mr. Hunt had very kindly referred to some experimental work upon which the writer had been engaged in illustration of the first portion of his paper. Fig. 4 was obtained, under the following conditions, with the aid of an oscillograph, and showed the current taken by a direct current motor starting against no load.

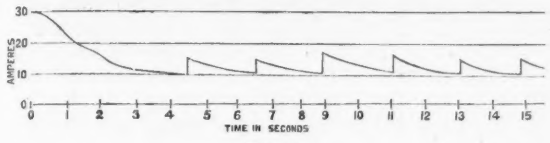



Fig. 4.

*Motor*—The motor tested was a standard type Westinghouse 7½ kw. four-pole 110-volt rotary converter, run as a shunt motor. The poles were fitted with copper damping pieces. The resistance of the armature, brushes, and connections was 0·084 ohm. The oscillograph shunt was 0·060 ohm., the leads, &c., being 0·290 ohm., giving a total of 0·434 ohm. The supply was from a battery, the voltage used being 92, so that the speed was 1,200 r.p.m.

The starting resistance, kindly lent for the experiments by Messrs. Bray, Markham & Reiss, was of the ratchet type. It had eight "speeding-up" contacts, the resistance on each contact being given in Table II.

The current curve traced by the oscillograph was photographically recorded on a film carried by a drum, rotated slowly by hand gear. Intervals of time were marked on the edge of the film by arranging a pendulum contact to cause a small glow lamp to give a flash of light every half-second, this being focussed as a dot on the film. It would be noticed that the time base was not uniform. The curve given was in this way to some extent distorted. The maximum oscillograph deflection was normally small. In order to double the deflection, an auxiliary voltage sufficient to produce the maximum negative deflection was permanently inserted in the oscillograph circuit, so that it was possible to work with a main shunt of double the value without injuring the oscillograph. The current peaks calculated as in Mr. Hunt's paper, and the actual values shown by experiment were given below:—

Table II.

| | Resistances (ohms). Starter. | Total. | Current peaks (amperes). Calculated. | Actual. |
|---|---|---|---|---|
| Contact No. 1. | 2·64 | 3·07 | 30 | 30 |
| " " 2. | 1·66 | 2·09 | 14·7 | 14·7 |
| " " 3. | 1·13 | 1·56 | 14·7 | 14·7 |
| " " 4. | 0·60 | 1·03 | 16·7 | 17·0 |
| " " 5. | 0·315 | 0·75 | 15·1 | 15·1 |
| " " 6. | 0·182 | 0·62 | 13·3 | 13·2 |
| " " 7. | 0·090 | 0·52 | 13·1 | 13·1 |
| " " 8. | 0·045 | 0·48 | 12·0 | 12·0 |

The actual current peaks were obtained by averaging the values of three separate experiments, one of which was given in fig. A. The close agreement between calculated and actual values of the current peaks showed that the armature self-induction did not affect the peaks in the way suggested by Mr. Hunt. Armature self-induction, as applied to the problem of starting currents, should apparently depend upon the amount of distortion of the main magnetic field per unit increase of current in the armature. Owing to the "stiff" field of this machine, this effect seemed to be small.

**Electrolytic Production of Calcium.**—A German patent has been granted to Ruff & Plato, of Berlin, for a process of winning calcium by the igneous electrolysis of its chloride. In order to obtain a pure metal, the inventors find it desirable to use a bath which answers the following requirements:—The specific gravity of the fused bath must be so high, and its melting point so low, that at the working temperature it is sufficiently fluid and sufficiently dense to allow the metal to rise to the surface easily. The bath must be free from other metals and silicates, or an alloy of calcium, or its silicide, will be formed; any impurity in the metal separated increases the difficulty of compressing the different particles into one compact mass. The working temperature must be as little as possible above the melting point of calcium. Based on these considerations, the inventors propose to prepare a bath containing 83·5 per cent. of calcium chloride and 16·5 per cent. of calcium fluoride, or an equivalent quantity of calcium bromide. The advantage of using the fluoride depends on its power of reducing the melting point, increasing the specific gravity, and raising the conductivity of the mixture. It may be heated to a suitable temperature, about 655° C., by an alternating current, and then submitted to electrolysis. The negative pole should be one or more iron rods, of such dimensions that they finally become red hot, but not white hot. The positive pole is carbon. An iron diaphragm extending to the surface of the melt is employed.

## ELECTRIC TIDES AND EARTH CURRENTS.

By W. H. SHARP.

(*Concluded from page* 287.)

The observers have not stated in this record to what year these January 1st to 6th observations belong, but indicate clearly that it must have been 1877, or 1878. It was desirable to ascertain which of these it was, so that the related lunar transit times, &c., might be compared. I, therefore, tabulated the necessary information, and observed that the features of the general chart seem to be connected with the lunar transits of January 1st to 6th, 1877. And, as will be seen by the following table, the actual lunar meridional transit intervals, taken directly from the "Nautical Almanac," *agree even more closely with the features of the electric tidal general chart than the mean intervals previously mentioned.* For instance, 12 h. 31 m. for January 1st, 1877, as the interval between superior and inferior lunar transit is nearer than 12 h. 24 m. 22 s., the mean interval, as a measure from 9.40 a.m., January 1st, zero in the general chart towards the zero occurring near 10.15 p.m.

Table of Lunar Transits, January, 1877. Meridian of Greenwich.

| 1 | | 2 | | 3 | | 4 | | 5 | |
|---|---|---|---|---|---|---|---|---|---|
| A.M. | P.M. | A.M. | P.M. | A.M. | P.M. | A.M. | P.M. | A.M. | P.M. |
| h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. |
| 1 16·1 | 1 47·1 | 2 16·7 | 2 45·0 | 3 11·9 | 3 37·6 | 4 2·3 | 4 26·3 | 4 49·6 | 5 12·5 |
| Supr. | Infr. | Supr. | Infr. | Supr. | Infr. | Supr. | Infr. | Supr. | Infr. |

I have shown that the general chart curve has not merely lunar, but has also solar tidal characteristic intervals, and if I can bring further evidence connecting the same with local aqueous tidal characteristics, I shall, to that extent, strengthen the proof that these electric tidal curves of earth current had a luni-solar origin or connection. And particularly that must be more obvious if I take the official tables for Peterhead local high water in the "Nautical Almanac," which are expressly calculated upon luni-solar data, and are as given below in civil time.

| January, 1877. | 1 | | 2 | | 3 | | 4 | | 5 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | A.M. | P.M. | A.M. | P.M. | A.M. | P.M. | A.M. | P.M. | A.M. | P.M. |
| H.W. at London Bridge | — | 2.57 | 3.22 | 3.48 | 4.13 | 4.37 | 5.1 | 5.26 | 5.50 | 6.13 |
| H.W. at Peterhead .. | — | 1.33 | 1.58 | 2.24 | 2.49 | 3.13 | 3.37 | 4.2 | 4.26 | 4.49 |

I have inserted on each of the five daily charts a × on the zero line, marking the approximate times of local high water, January 1st to 6th, 1877; also, disregarding at present the inequality of the actual intervals between low and high water, I have marked each chart with **O** on the zero line, at times half way between high water times to indicate mean times near low water. The approximate correspondence of such high and low water times with the respective positive and negative electric maxima is too obvious to require further remark, as also is the connection with the lunar semi-diurnal transit intervals, irrespective of the year in which these January 1st to 6th observations were made.

I have marked half the mean intervals—3 h. 6 m. 5½ s.—between low and high water (local) on the five day charts by arrow heads on the zero line, showing the approximate time of maximum aqueous tidal acceleration. When in a rising tide the arrow head points upward, when in a falling tide it points downward.

Observe that those marks closely correspond with the times of entirely independent galvanometer zero readings.

The moon had been full at 9 h. 58·8 m. p.m., December 30th, 1876; was in perigee on December 31st, 1876, and entered its last quarter at 2.17 p.m., January 6th, 1877. The sun was in perigee at 5 p.m., December 31st, 1876, and the general luni-solar conditions existing January 1st, 1877, were favourable for producing a high water spring tide locally.

In order to appreciate the significance of these electric tidal charts, consider our earth to be a rigid sphere, and let B, C, D, E, F, G, H, I, in fig. 1, represent the ends of eight

equal radii thereof, drawn upon a reference plane passing through the earth's centre, A.

Let the earth be concentric with and included within an invariable spherical surface of reference, and let J, K, L, M, N, O, P, Q represent the ends of eight equal radii thereof drawn in the reference plane aforesaid. If the space between the earth's surface and the aforesaid invariable spherical surface of reference be filled with an electric medium of invariable volume, its depth over every part of the earth's

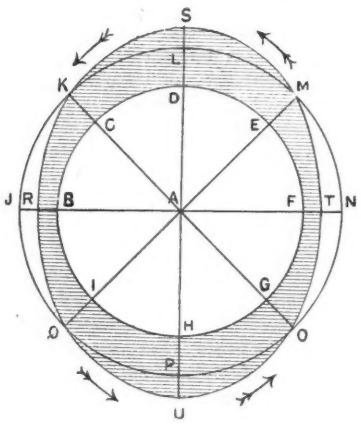



FIG. 1.

surface will be uniform. But though that medium's volume remains invariable, let its form be variable, and let us suppose that under the electric influence of our moon its form is varied so that it becomes an ellipsoid surrounding the earth, and having its major axis S, U, and a minor axis, R, T, in the aforesaid reference plane. Assume, temporarily, that the ellipsoid remains concentric with the earth, and with the invariable spherical surface of reference throughout. In that case there would no longer be a uniform depth of the electric medium over every part of the earth's surface, but there would be an increased depth in two regions or caps outside the spherical surface of reference and symmetrically situate round L, S, and P, U, the projecting ends of the ellipsoid's major axis.

Also, in that case, there would be a decreased depth of the electric medium in one region or belt inside the spherical surface of reference and extending symmetrically all round the earth between the caps aforesaid, and that "belt" or region of defect would in volume exactly equal the combined volume of the two "caps" or regions of excess.

Now, let the shaded portion in fig. 1 represent a section in the same reference plane of the ellipsoid. Then, K, L, M, S, represents the plane section of one of the caps, and O, P, Q, U the corresponding section of the other cap. Also, the unshaded areas, K, R, Q, J and M, N, O, T represent plane sections in the reference plane, of the vacated region or belt of defect inside the invariable spherical reference surface.

As at rest in fig. 1, no alteration of the depth of the section of enveloping medium has resulted from the ellipsoidal deformation if we consider only the four lines C, K; E, M; G, O; and I, Q. Now, suppose our moon to revolve at its usual rate in the reference plane aforesaid around our earth, shown in section in fig. 1, and from centre A, then the enveloping medium, in the course of 24 h. 48 m. 44 s. would turn, so that its major axis would make a complete revolution.

Assuming the earth at rest with reference to the moon, a succession of electric phenomena would pass, say, a fixed point, E, in the course of each lunar revolution in the direction of the arrows in fig. 1. Suppose yourself provided with a galvanometer set to read zero at E, and capable of having its needle deflected to one side or the other thereof, according as it might be influenced by local excess or defect respectively in the depth of the enveloping medium aforesaid.* You might note eight distinct intervals, divided into four pairs, with four zeros alternating with those pairs, in the course of one lunar day:—

1. After recording zero at E to begin with, there would be an increasing defect of the medium until T, N, its negative maximum arrived.

2. After that negative maximum, there would be a decreasing defect of the medium until O arrived, when the deflection would become zero, and a $\frac{1}{4}$ lunar day would have ended the first pair of intervals of defect, and one side of the "belt" would have passed.

3. From zero, a deflection of the needle to the other side would begin and continue increasing until the excess of the medium attained its maximum with the passage of P, U.

4. After recording that, say as a positive maximum, there would be a decrease of the excess and the positive deflections until Q arrived, and half the lunar day would end at zero. With the first pair of intervals of excess one of the two "caps" has passed.

With the successive arrivals of J, K, S, and M during the following half lunar day, the phenomena of the four intervals above detailed would be repeated in the same order.

If observations were taken and reduced to a chart such as I have used, one lunar revolution would give under such conditions two galvanometer needle double oscillations, as a sine curve about a zero line somewhat resembling fig. 2.

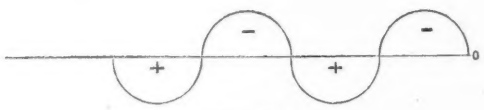



FIG. 2.

A solar sine curve would similarly be completed in about 24 hours, but because of the sun's greater distance the amplitudes of the galvanometer needle's oscillations would be less. If now we combine a lunar and a solar electric tidal curve, it is clear that at certain intervals those bodies act together, and that at other intervals they act in opposition. The effects will be represented in the compound curve, as also will the effects of the varying phases and magnitudes being combined, but allowances for many modifying influences have to be made to approximate closely to the galvanometer curves used herein.

As to whether luni-solar electric tidal phenomena are mere secondary effects of aqueous tidal pressure or friction, or whether the converse is nearer the truth, much might be said if space permitted.

No doubt many will prefer to adopt the former view. But at least those phenomena have one common origin, and if it be necessary to consider one as secondary to the other, the aqueous tidal phenomena are secondary to the electric tidal phenomena. The aqueous medium is not continuous in kind from the earth to moon or sun, whereas the electric mechanism fills and extends infinitely beyond the solar system, and into the most minute sub-divisions of its constituent parts. Fresnel, Arago, and Wheatstone, advanced our knowledge of the polarisation of that electric medium; and since then more or less confusing, erratic, arbitrary and elusive observations of earth current variations of direction and magnitude in subterranean and aerial lines, as well as in submarine lines, have long been accumulating.

Thanks to such men as Gauss, Sabine, Faraday, Ampère and Hertz, we can now realise more clearly than was possible in the time of Huyghens, some of the necessary consequences of regarding our earth as surrounded by a universal electric medium. It now appears to be surrounded by an eccentrically rotating field of luni-solar electric tidal currents in that medium.

Obviously, the luni-solar electric tidal variations I have proved herein, must have been accompanied by luni-solar electric tidal variations at every point in the line, representing the axis of that cable, continued as a circle round the earth, at every point in the plane of that circle extended, and at every point in space, though masked by local conditions. Those variations are incessant, infinite and periodic; they afford an independent and electrically measureable definite connection between celestial and terrestrial phenomena.

* I use this term merely as an index of positive or negative pressure, &c., and I do not know two kinds of electricity, therefore I speak of excess and defect.

## OUR IRON AND STEEL TRADE.

[COMMUNICATED.]

That the first volume of the reports of the Tariff Commission deals with the iron and steel trades is probably due to the importance of those trades. The report is not a very convincing document, and appears to be founded very largely on misconceptions fostered by an infinite lack of the sense of proportion.

Thus to quote from Section V. we are told that "The witnesses . . . . . are of opinion that given the great lead which the British iron and steel industry had over that of all other countries there was no reason in natural conditions why that lead should not have been maintained." Let this statement be examined in the light of cold reason, going back for figures no further than the year 1876, in which year nearly half the production of pig-iron was British, and our production in thousands of tons was 6,660 out of a total of 14,810. In 1903 all countries produced 47,340, so that our production should have been about 23,000, whereas it was only 8,810. In 1876 we produced over three times as much as Germany. The maintenance of this lead would give us in 1903 over 30,000. Compared with the United States, whom we distanced threefold in 1876, we ought to-day to produce 54 million tons of pig-iron.

Thus the report which asks us to believe that our lead should be maintained leaves us in doubt between a present-day production of 23, 30 or 54 millions of tons. The annual consumption of pig iron per head of population in pounds to-day is 412, while Germany uses 367, and the United States 517 lbs. Taking the same test and comparing with 1876, when we more than trebled Germany's *per capita* consumption we ought to-day to consume nearly 1,200 lbs. Compared with the United States, we ought to consume very close on 1,900 lbs. per head. All our back gardens would be full of pig-iron by this time. These figures are a *reductio ad absurdum*, but they are a very fit answer to the foolish claim about maintaining our lead, for had we maintained our lead the production of pig-iron in this little island would to-day be actually greater by 7 millions of tons than the whole production of the world, and who then would have used it all up?

The world's production would have been 1,130 millions instead of 47 millions, and the 300 years' endurance of our coal fields, had other industries kept pace, would have been cut down to less than 50 years, at the end of which time our population of 280 millions would suddenly find itself out of employment. We say 280 millions because only the members of the Tariff Commission will believe it possible to multiply our production by seven and keep our population down to 40 millions.

What, apparently, the members of the Commission lack is a series of maps drawn to the same scale. The page maps of the school atlases really do give to children false ideas of relative areas from which they never recover. Even to-day the average American does his boasting on the basis of the school atlas, and institutes all manner of comparisons between the United States and Britain, *i.e.*, between four million and 120,000 square miles. In any country, if all its able-bodied inhabitants were employed, that country would be happy and prosperous. If it were not for alien immigration there would be no need for Englishmen to be out of work to-day, but the employers on the Tariff Commission do not seem to ask for the exclusion of the alien criminal or worker, or for the application against the United States of the contract labour law which the States enforce against Englishmen.

To return to pig-iron, it must be observed that the world's increased production has taken place in Germany and the United States, both countries emerging from a previous state of semi-barbarism. Germany had just adopted Free Trade within her borders, and the United States had got rid of the incubus of slavery, and all that this meant, and had commenced to develop her territory. To-day considerable progress has been made, but the United States is still far behind us in the extent of railroad development per square mile of country. Further, our own lines have been advanced many years to their present mileage, or very nearly so, and only consume on renewal account. Germany's progress may be described on similar lines, for her area and population are both much larger than our own. Moreover, Germany was kept back as an iron, or rather steel, producing country by the unsuitability of her phosphoric ores. Until Thomas and Gilchrist showed them and us how to treat their phosphoric pig in basic furnaces the Germans could not make steel.

In view of the boasted progress of the United States, is it not something of which they ought to be ashamed, that even now they produce less pig-iron than ourselves, plus the Germans? These two countries, together equal to a fraction of the United States, and with a population not seriously greater, produce more pig-iron than is produced on the whole continent of North America. Yet the tariff reformers want us alone to do three times as much as America and Germany together!!! The argument is ridiculous, for our production has reached the probable present demand per head of an old and settled country. Were we to produce more, it would be necessary to remove our people from other occupations, possibly of a pleasanter order.

As regards the consumption of steel by different countries, the extension of railways is sufficient to account for the rapid growth in other nations which are still behind us in railway mileage per unit of area, and it might further be added that the steel production of Great Britain was probably abnormal for its size before the discovery of the basic process opened out the idle riches of Germany.

From Section III. of the report, it is clear that our home consumption of iron, reduced to a pig basis, has risen more since 1890 than our production has grown, but 1890 was a bad year, very much worse than 1876, and hardly a fairly comparative year; for exports were high, and we were suffering from the Argentine collapse, and paying for something in large iron exports in place of using the iron at home.

In 1902 we imported a lot of pig-iron equivalent, which showed we must have been working it up probably to higher grade articles.

But if exports are good for a country, their growth from 1,907 thousands as the average of 1893-7, to 1,974 thousands in the period 1898-1902, and to 2,460 in 1903, ought not to shock the tariff reformers.

Including pig-iron, the figures are 2,862, 3,133 and 3,526, and the increase is greatest to the British Colonies, and leads one to think that, if such growth has taken place, the conditions had better remain as they are. The figures, indeed, strongly suggest that we should leave well alone, for in order to send manufactured articles to the Colonies, we have had to supplement our raw materials by imported semi-finished stuff which has certainly not been paid for with gold. Yet, in spite of these imports, we cannot keep pace with the Colonial demand, and they naturally go elsewhere for some of their needs.

On the question of competition, fair or unfair, of the foreigner, the question of dumping has been much to the fore. We will not question that possibly it does pay the foreign producer to dump some of his product at a low price, but it does not pay his country to do so. He can only dump because he gets a big home price. The report shows that the foreigner in a given instance can sell 59 per cent. of his product at a dumping price without loss.

Pittsburg dump prices were 75s. for billets c.i.f. British ports, against 100s. to the Americans. Who paid the 25s. excess? In the long run it was partly paid by the Western farmer, who helped to pay for the railways built with costly Pittsburg steel, and to such extent, of course, the British farmer had less keen competition to meet from the American wheat grower.

The report, in paragraph 66, seeks to twist the profit of dumping from the producer, who may really secure a profit, to his country, which certainly makes a loss.

On the question of meeting foreign competition, the action of our manufacturers does not lend colour to their claims. Why have the Belgians and the Germans done so much to use their waste furnace gases where our own ironmasters have practically neglected this economy? Their apathy in this direction invites us to believe that they are equally apathetic in other directions where economy might be secured.

To-day there are complaints that our steamship rates are higher to South African ports than the rates from either Ant-

werp or New York. We would be no party to the folly of allowing foreign ships, ill-found, overloaded and undermanned, to enter British ports in competition with British ships regulated to safe limits. There are many ways in which British trade is hampered by legislative control from which the foreigner is wrongly exempt. We have no special belief in the foreigner, nor do we believe in his goodwill to this country. But when it comes to dumping goods which we can raise to a higher grade—and the report before us seems to point to this being the main end of dumped stuff—it does appear to us that to exclude such goods would be to cut off a stream of raw material which we could ill spare, and it would involve the manufacture at home of more raw material at the expense of our national capital, Coal. Coal is a rapidly diminishing asset, and where foreign goods are paid for by coal, it appears to us we are paying away our chief asset.

The Tariff Commission would do well to ponder over the conclusion at which Prof. Lotz (B.A. Cambridge meeting) arrived, as to the effect of Protection on some German industries :—

"Considered from an evolutionist standpoint," he said, "the present state of protection of bulky and syndicated industries tended to deprive Germany and other countries in an analogous position of the best natural advantage which they possessed in competition with the other parts of the world, *i.e.*, of superiority in the cheap and skilful production of finished articles."

The meaning of this is unmistakeable.

*(To be concluded.)*

## NEW PATENTS APPLIED FOR.

**Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.**

17,248. "Improvements in and relating to fenders for electric cars and other vehicles." F. R. Keith. August 8th. (Complete.)

17,248. "Improvements in accumulators." J. Byrom. August 8th.

17,268. "Improvements in or relating to electrical indicating apparatus for a range finder or the like." T. Kirkland and D. L. Capper. August 8th.

17,339. "An improved electric switch." W. G. Heys. (The Meyrowitz Manufacturing Co., United States.) August 9th. (Complete.)

17,358. "Electric hygienic heel pad." L. Nelken. August 9th.

17,359. "Improvements in apparatus for cleaning telephone and like switchboards." F. L. Bronaugh and The British Compressed Air Cleaner Co., Ltd. August 9th.

17,364. "Improvements in means for preventing the breaking of an electric circuit." E. G. P. Bousfield and The Ozonised Oxygen Co., Ltd. August 9th. (Complete.)

17,371. "Improved appliance for removing carbonised matter from tobacco pipe bowls." W. S. Rowntree. August 9th.

17,374. "Improvements in wave telegraphy." R. A. Fessenden. August 9th. (Complete.)

17,377. "Wave indicator for wireless electric telegraphy." G. Engisch and The "Deutsche Erfinder-Genossenschaft." August 9th. (Complete.)

17,434. "Improvements in and connected with electric lamps for medical purposes." A. Lloyd. August 10th.

17,442. "Improvements in electric controllers." W. H. Scott. August 10th.

17,469. "Improvements in electric alternate-current motors." S. P. Thompson. August 11th.

17,478. "Improvements relating to electric light fittings." J. Marsden. August 11th.

17,483. "A receiving system for wireless communications." W. Harbison. (Date applied for under Patents Act, 1901, August 27th, 1903, being date of application in United States.) August 11th. (Complete.)

17,484. "A receiving system for wireless communications." W. Harrison. (Date applied for under Patents Act, 1901, February 8th, 1904, being date of application in United States.) August 11th. (Complete.)

17,493. "An improved transmitter for electric telegraphs." M. G. Potiewski. August 11th. (Complete.)

17,501. "Improvements in 'cow catchers' for electric and other cars." W. T. Eastwood. August 11th.

17,523. "Improvements in liquid starting resistances for continuous-current motors." F. M. Lewis. August 11th.

17,527. "Improvements in commutators for dynamo-electric machines." Siemens Bros. & Co., Ltd., and H. Berry. August 11th. (Complete.)

17,532. "Improvements in electric fitters." F. B. Hibbson and S. H. Hey. August 11th. (Complete.)

17,553. "Improvements relating to electric dynamos, motors, and the like." E. E. Kelsey. August 12th.

17,562. "Improvements in printing telegraphs." J. D. White. August 12th.

17,605. "Improvements in insulating electric cables on the conduit system." G. E. Heyl-Dia. August 12th.

17,611. "Improvements in electric imitation candles." Messrs. Drake and Gorham, Ltd., B. M. Drake and J. H. Gorham. August 12th.

17,620. "Improvements in, or in connection with trolley poles (used on electric tramcars) for changing from one wire to another." J. Bennett and H. G. Crompton. August 13th.

17,621. "Improvements in electric arc lamps." Veritys, Ltd. August 13th.

17,627. "Improvements in regulation or graduation of the electric light of an incandescent lamp." P. C de Azenedo. August 13th.

17,632. "Improvements in, and connected with, means for operating the points of electric tramways and the like, and also the overhead points or trolley switches, and in devices for actuating such operating means." N. Norris. August 13th.

17,639. "Improvements in connection with electrolytic cells." W. Thomson. August 13th.

17,650. "An improved electrolytic rectifier." M. Buttner. (Date applied for under Patents Act, 1901, August 13th, 1903, being date of application in Germany.) August 13th. (Complete.)

17,672. "Improvements in batteries." G C. Dymond. (N. M. Watson & E. S. Wheeler, United States.) (Complete.)

## PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

### 1903.

Electrical Resistances or Rheostats Applicable as a Regular Motor Starting Switch or the like. S. G. Brounger and W. G. Haywood. 14,814. July 3rd.

Construction of Apparatus for the Electric Disposition of Metals. J. W. Collis, A. Collis, and W. Head. 15,817. July 10th.

Safety Collision Devices for Electric Tram-Cars. R. Haddan. (Ramon Rué y Montparlé, Spain.) 17,814. August 17th.

Electro-magnetically Operated Apparatus for Controlling the Inlet Devices of Steam and Gas Turbines. T. Reuter. 26,144. November 20th.

Electric Telegraphy. H. O. Rugh. 28, '01. December 20th.

### 1904.

Electric Railways. L. W. Pullen. 789. January 12th.

Electric Telegraph Systems. C. Adams-Randall. 1,978. January 26th.

Telegraphic Transmitters. W. L. Wise. (J. H. Peirce, United States.) 2,274. January 29th.

Connections or Connecting Pieces for Electricity Conductors. H. Hirsch. 3,022. February 6th.

Electric Meters. F. P. Cox. 5,097. March 1st. (Date applied for under Patents Act, 1901, March 2nd, 1903, being date of application in United States.)

Electric Lamps. C. P. Steinmetz. 5,098. March 1st. (Date applied for under Patents Act, 1901, March 6th, 1903, being date of application in United States.)

Fuse Boxes. E. Roberts and P. Good. 5,207. March 3rd.

Insulating Linings for Covers or Containers for Electrical Apparatus. C. M. Dorman and R. A. Smith. 5,861. March 10th.

Electric Melting Furnaces La Societe Anonyme l'Industrie Verriere et ses Derives. 5,921. March 10th. (Date applied for under Patents Act, 1901, March 21st, 1903, being date of application in Belgium.)

Electrical Ignition Apparatus for Internal Combustion Engines. A. J. Postans. 1,246. January 18th.

Electrical Signalling Apparatus. A. Pieper. 1,714. January 22nd.

Electric Cables and the like. J. Stratton and E. A. Claremont. 1,847. January 25th.

Utilising the Waste Ends of Carbons from Arc Lamps. R. Peters. 2,367. January 30th.

Automatic Electrical Switches. A. S. Adler. 2,438. February 1st.

Contact Shoe for Electric Railways. N. Rosenfeld. 2,504. February 1st.

Clockwork Electricity Meters. H. Aron. 2,466. February 1st.

Flexible Conduits for Electric Conductors. H. H. Lake. (J. S. Wilson, United States.) 3,212. February 9th.

Indicating Electrically at a Distance the Movement of a Needle. A. River. 3,246. February 9th.

**Electric Lighting and Traction at Rangoon.**—A recent issue of the *Rangoon Gazette* contains the statutory notifications concerning the nature of the supply to be undertaken, and the nature of the licence for which the concessionaires (Messrs. J. W. Darwood & Co.) have applied. So far as the electric tramways are concerned, no relief is sought from the provisions of the Government of India Rules Regarding Licensed Undertakings, of December 23rd, 1903. The traction system will be of the trolley wire kind with continuous current, because the Madras *fiasco* of the early nineties has probably stopped all desire to dabble with conduit systems in British India. The feeders will probably be aerial, 600 will be the maximum voltage as provided in the rules. However, while continuous current is to be generated for the tramways, the lighting is to be from an alternating current supply. The pressure is to be "within the limits of high-pressure supply" (*i.e.*, in India under 3,000 volts), and the frequency permissible not less than 50, or more than 60 cycles per second. While the generation will be three-phase, the distribution will be single and three-phase with two, three, or four wires. To the public lamps, and to motors of over 50 H P., the concessionaires seek to be allowed to deliver high-tension currents, transforming down to within the low-tension limits for smaller power users and private lighting. As the rules only provide for the carrying of aerial lines for electricity supply on both sides of the street when special sanction is obtained, power to do this is sought. It is also proposed to carry high and low-pressure aerial lines on the same supports where aerial lines are by reason of telegraph or telephone lines confined to one side of the street. It is further proposed that transformers may be carried upon the supports carrying high and low-pressure conductors, transformers so placed being deemed to be "in suitable places" in "the sole occupation and charge of the licensees" when carried upon such poles or supports that they cannot be reached except by means of a ladder or other special devices. This last proposal seems to savour of pioneer electrical engineering in its roughest, hastiest, "hustlingest" Western American stage, and will, it seems to us, probably meet with strenuous objection from the Government's consulting electrical engineer.